Aviation Week

Including **Space Technology**

November 24, 1958

Navy Studies Liquid Engine Packaging

Army Jupiter IRBM

BRUNSWICK TURNS OUT SHAPES WITH FANTASTIC FIDELITY

Brunswick has revolutionized the technology of fiberglas laminates with its exclusive new Strickland B Process (SBP). This unique method not only creates components with extremely high strength-to-weight ratios and heat resistance (up to 600°F.), but it also opens up a mass production system that meets fantastic new standards for precision.

SBP filament-wound laminates can be mass produced by fully automated machines. Whether one or one thousand . . . simple or compound configurations, including monocoque structures, SBP laminates meet the most rigorous space age specifications for precision and uniformity in skin thickness, size, dielectric constant and contours.

Brunswick research and development groups continually work to extend upper temperature limits and other unique features of SBP laminates. They also offer you skillful help solving problems in design, development and fabrication. Write The Brunswick-Balke-Collender Co., Defense Products Division, 1700 Messler St., Muskegon, Michigan.

BRUNSWICK

MAKES YOUR IDEAS *WORK*

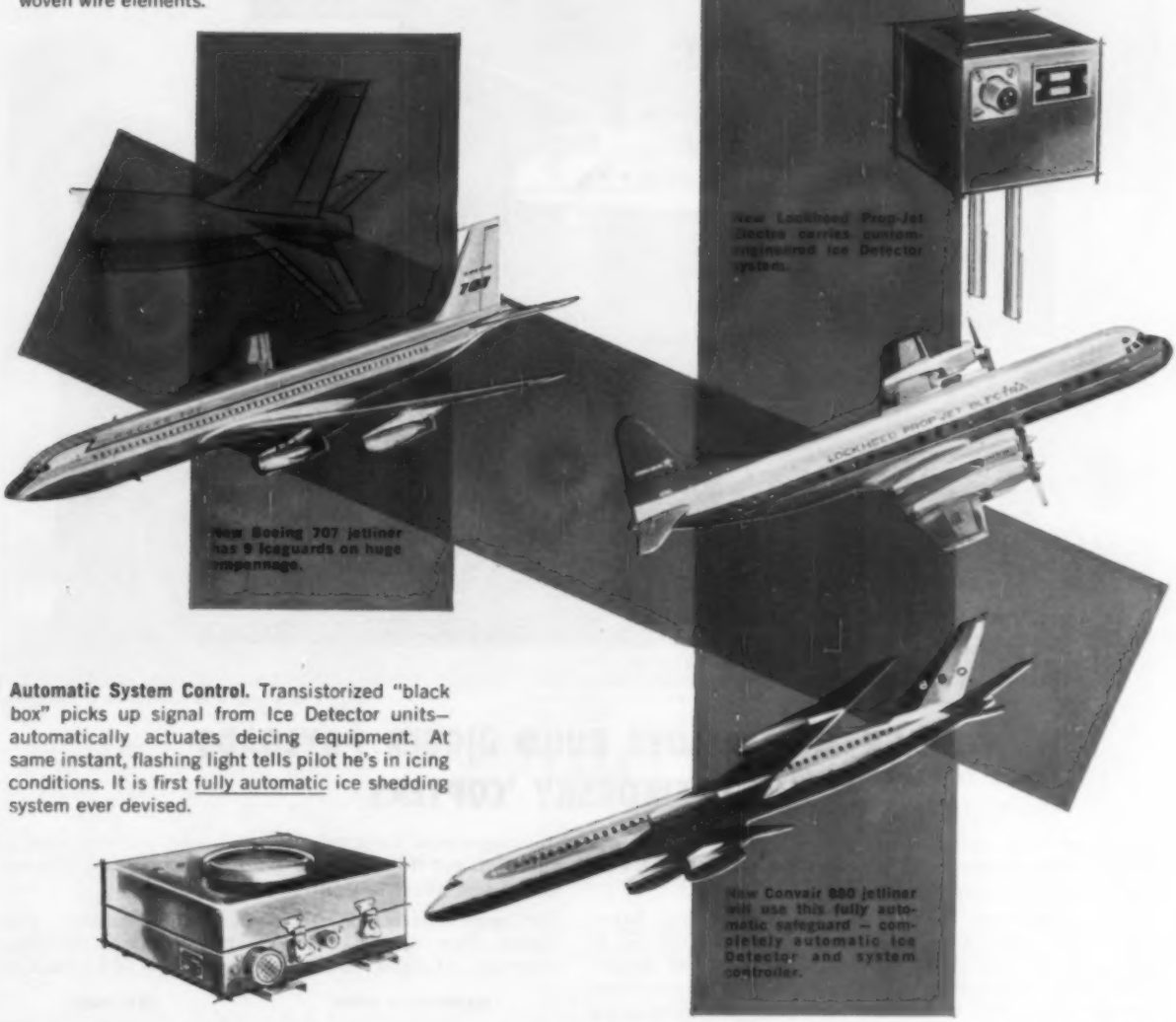
FROM GOODYEAR

most advanced ice protection

for 3 of the world's newest airliners

Iceguard—dependable ice protection for any aircraft surface or shape. Electrothermal sheathing by Goodyear conforms readily to thinner wings of jet aircraft, has specially compounded cover for high erosion resistance. Available in two types: electrically conductive rubber or rubber-embedded woven wire elements.

Automatic Ice Detector senses ice build-up precious seconds before pilot can see it. Lightweight sensing "probes" extend into air stream, flash warning to pilot as plane enters icing conditions. Detector has been proved in Arctic Circle operation—is USAF qualified.



New Boeing 707 jetliner has 9 Iceguards on huge empennage.

New Lockheed Prop-Jet Electra carries custom-engineered Ice Detector system.

New Convair 880 jetliner will use this fully automatic safeguard – completely automatic Ice Detector and system controller.

Automatic System Control. Transistorized "black box" picks up signal from Ice Detector units—automatically actuates deicing equipment. At same instant, flashing light tells pilot he's in icing conditions. It is first fully automatic ice shedding system ever devised.

Combined Research of Goodyear and National Research Council of Canada produced Iceguard. Automatic Ice Detector system—developed by National Research Council and Canadian Applied Research Limited—is represented solely by Goodyear in the U. S. **For help with your icing problem,** write Goodyear, Aviation Products Division, Akron 16, Ohio, or Los Angeles 54, California.

GOODYEAR

AVIATION PRODUCTS

Iceguard—T.M. The Goodyear Tire & Rubber Company, Akron, Ohio

white areas show extensive use of magnesium

MAGNESIUM ALLOYS BUILD BIGGER PAYLOADS INTO SIKORSKY 'COPTERS

Structural dead weight—that ever critical problem in the design of air frames and missiles—is a problem Sikorsky Aircraft solved several years ago.

As every helicopter designer well knows, everything below the rotor is sheer dead weight and contributes nothing to lifting the aircraft. So it's no wonder Sikorsky uses magnesium alloys where they can. This lightest of all structural metals weighs only 65% as much as aluminum. Easy to see how the use of magnesium adds substantially to the payload—by subtracting weight from the structural load.

The S-56, Sikorsky's largest 'copter to date, carries a total of 5,558 lbs. of magnesium. This total includes the wheels, almost the entire skin and numerous other components. Several highly stressed areas, such as the rotor hub plates, are magnesium forgings. Other Sikorsky models, such as the S-58 and S-55, famous Korean War 'copter, also use magnesium alloys to good advantage.

For more information about magnesium, contact your nearest Dow Sales Office or write THE DOW CHEMICAL COMPANY, Midland, Michigan, Department MA 1402-K-4.

MAGNESIUM FORM	LBS. USED		
	S-55	*S-58*	*S-56*
Sheet	580	1303	2288
Extrusions	68	51	246
Castings	307	266	1466
Forgings	77	198	1144
Bar and Tube	83	186	414
Total	1,115	2,004	5,558

YOU CAN DEPEND ON DOW

AVIATION CALENDAR

Dec. 1-5—Annual Meeting, American Society of Mechanical Engineers, Hotels Statler-Hilton and Sheraton-McAlpin, New York, N. Y.

Dec. 2-4—Third Conference on Reliable Electrical Connections, sponsored by Electronic Industries Assn., Dallas, Tex.

Dec. 3-5—Second National Symposium on Global Communications, sponsored by the Institute of Radio Engineers and American Institute of Electrical Engineers, Colonial Inn, St. Petersburg, Fla.

Dec. 3-5—Eastern Joint Computer Conference and Exhibit, Bellevue-Stratford Hotel, Philadelphia, Pa.

Dec. 4-5—Ninth National Conference, Professional Group on Vehicular Communications, Institute of Radio Engineers, Hotel Sherman, Chicago, Ill.

Dec. 8—Symposium on High Speed Testing, sponsored by Plas-Tech Equipment Corp., Sheraton-Plaza Hotel, Boston, Mass.

Dec 9-11—Mid-America Electronics Convention, sponsored by Kansas City Section, Institute of Radio Engineers, Municipal Auditorium Arena, Kansas City, Mo.

Dec. 11-13—Southeastern Regional Meeting, American Chemical Society, University of Florida, Gainsville, Fla. Redstone Arsenal scientists will conduct two symposia on Dec. 13: technical papers on missile chemistry and missile chemistry for students and teachers.

Dec. 16—Fourth Convertible Aircraft Congress, the Franklin Institute, Philadelphia, Pa. (Changed from Nov. 28)

Dec. 17—22nd Wright Brothers Lecture, Maurice Roy on French aeronautical research, Natural History Bldg., Smithsonian Institution, Washington, D. C.

Dec. 27-30—Fifth Annual Meeting, American Aeronautical Society, Hotel Statler.

(*Continued on page 6*)

AVIATION WEEK Including Space Technology

November 24, 1958

Vol. 69, No. 21

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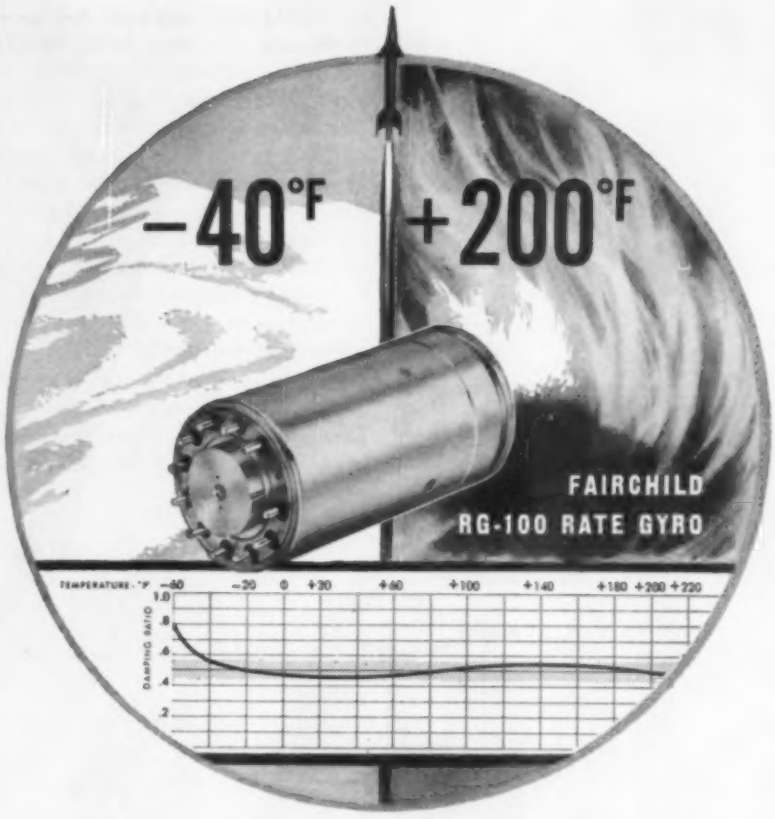

Fairchild's Sub-Miniature Rate Gyro Has FULLY CONTROLLED DAMPING

Only Fairchild's Rate Gyro—has uniform, constant damping for any required percentage of critical within ±15% and over the entire operating temperature range of —40° to +200°F. This is accomplished by varying the damping area, using the damping medium as a sensing device which varies with temperature changes.

TAKES 100 g's OF SHOCK

Only Fairchild's Miniature Rate Gyro takes 100 g's of shock and 15 g's at 2000 cps vibration even at rates as low as 20° per second. This high shock resistance is due in part to Fairchild's exclusive design feature which does not require the torsion bar to act as a supporting medium.

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INPUT RATES (Full Scale)	±20 to ±800 degree/second	**OUTPUT**	6 volts, 400 cps, phase sensitive
SIZE & WEIGHT	15/16" dia. x 2" long — 2 ounces	**LINEARITY**	0.1% to half scale 3.5% to full scale
MOTOR	2 or 3 phase; 6.3V or 26V AC	**NULL**	15 to 40 mv total depending upon maximum rate and damping.

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WASHINGTON, D. C.

THE 12 E DEMONSTRATES THAT PERFORMANCE PAYS ON THIS JOB FOR PORTA HOUSE, OAKLAND, CALIF.

AVIATION CALENDAR

(Continued from page 5)

Washington, D. C. Meeting will be held in conjunction with the 125th Annual Meeting of the American Assn. for the Advancement of Science.

Jan. 12-14—Fifth National Symposium on Reliability and Quality Control in Electronics, Bellevue-Stratford Hotel, Philadelphia, Pa.

Jan. 19-21—11th Annual Convention, Helicopter Assn. of America, Villa Hotel, San Mateo, Calif.

Jan. 26-29—27th Annual Meeting, Institute of the Aeronautical Sciences, Sheraton-Astor Hotel, New York, N. Y. Honors Night Dinner, Jan. 27.

Jan. 27-29—Fifth Annual Radar Symposium (classified), Rockham Bldg., University of Michigan, Ann Arbor, Mich.

Jan. 27-30—15th Annual Technical Conference, Society of Plastics Engineers, Hotel Commodore, New York, N. Y.

Jan. 28-29—Fifth Annual Midwest Welding Conference, sponsored by Armour Research Foundation, Illinois Institute of Technology, Chicago, Ill.

Feb. 3-5—14th Annual Technical and Management Conference, Reinforced Plastics Division, Society of the Plastics Industry, Inc., Edgewater Beach Hotel, Chicago.

Feb. 12-13—1959 Solid State Circuits Conference, sponsored by Institute of Radio Engineers' Professional Group on Circuit Theory, American Institute of Electrical Engineers' Committee on Electronics and University of Pennsylvania, Philadelphia.

March 3-5—1959 Western Joint Computer Conference, sponsored by Institute of Radio Engineers, American Institute of Electrical Engineers and Assn. for Computing Machinery, Fairmont Hotel, San Francisco, Calif.

March 5-6—Flight Propulsion Meeting (classified), Institute of the Aeronautical Sciences, Hotel Carter, Cleveland, Ohio.

March 8-11—Engineering meeting on the turbine in action, sponsored by Gas Turbine Division of the American Society of Mechanical Engineers, Cincinnati, Ohio.

March 16-20—11th Western Metal Exposition and Congress, American Society for Metals, Pan-Pacific Auditorium and Ambassador Hotel, Los Angeles, Calif.

March 31-Apr. 2—Polytechnic Institute of Brooklyn's Ninth International Symposium. Subject: Millimeter Waves. Auditorium, Engineering Societies Bldg., New York, N. Y. Co-sponsors: Department of Defense Research Agencies and Institute of Radio Engineers.

Apr. 7-10—1959 Welding Show and 40th Annual Convention, American Welding Society, International Amphitheatre and Hotel Sherman, Chicago, Ill.

May 4-7—Fifth Annual Flight Test Instrumentation Symposium, sponsored by the Instrument Society of America, Seattle Section, Olympic Hotel, Seattle, Wash.

May 25-27—1959 National Telemetering Conference on Investigation of Space, Brown Palace and Cosmopolitan Hotel, Denver, Colo. Sponsors: American Rocket Society, Institute of the Aeronautical Sciences, American Institute of Electrical Engineers and Instrument Society of America.

COMPUTATION— IN THE DEADLY GAME OF SURVIVAL

BURROUGHS SYSTEMS STUDIES PLAY A VITAL ROLE IN DEFENSE

Problem: How to puncture-proof our air defense against enemy bomber and missile threats. Solution: Systems Studies of all operational problems—studies whose very heartbeat is electronic computation. Burroughs is acknowledged a master in all phases of such computation and its related areas, through its priceless combination of technical competence, outstanding experience and the most advanced research facilities.

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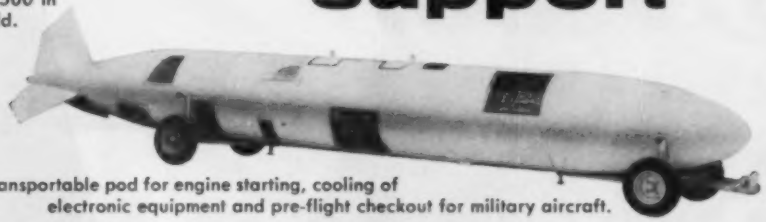
Dual carts for main engine starting, air conditioning and electrical power for military aircraft.

Reliable and versatile ground support

AiResearch MA-1A trailer for starting military aircraft. Nearly 2,500 in the field.



Air transportable pod for engine starting, cooling of electronic equipment and pre-flight checkout for military aircraft.

Lightweight Freon system, usually installed in a van or trailer, for cooling electronic equipment in support of missiles.

AiResearch Aviation Service Company ground support equipment is tailored to meet turbine powered aircraft and tactical missile requirements. Lightweight, compact units can be designed to specific configurations or installed on standard vehicles.

Heart of the lightweight ground support systems are AiResearch gas turbine compressor power units. Capable of delivering both electrical and pneumatic power, nearly 8,000 of these units are operating successfully and dependably in the field.

Support services can include: main engine starting, pressurization and air conditioning of cabins and compartments, missile pre-flight check-out, removal of snow and ice from aircraft and equipment, supply of DC or AC electrical power at any required frequency, and low pressure, high flow air for operation of a variety of actuation systems. The units have push button starting and operate without delay under all weather conditions.

The Garrett Corporation, through its AiResearch divisions, is the world's largest producer of lightweight turbomachinery. The AiResearch Aviation Service Company can package both AiResearch equipment as well as that of other manufacturers to meet your individual ground support requirements. Your inquiries are invited.

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The U. S. Navy's guided-missile the Regulus II, built by Chance Vought Aircraft, is capable of delivering a nuclear warhead with "pin point accuracy" to targets over 1,000 miles distant at speeds in excess of Mach 2 and altitudes above 60,000 feet. Retaliatory weapons such as the Regulus II guarantee our national security.
Hi-Shear Rivets insure structural integrity in the Regulus by meeting the environmental conditions of high strength at elevated temperatures encountered during missile flight.
Regulus II
NAVY
Research and development in Hi-Shear laboratories has continued to keep pace with advances in the missile industry by investigating new materials, methods and fastener design. Hi-Shear Rivets are now being manufactured in a full range of sizes and many materials, including:
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Get lighter weight, higher reliability with complete ducting systems by Solar

COMPLETE DUCTING SYSTEMS—designed to withstand rugged environmental extremes—are being created at Solar. Behind every Solar ducting component is more than thirty years of experience in producing top-quality aircraft components requiring advanced materials and imaginative fabricating techniques. Result: Solar today offers complete ducting and boundary layer control systems—designed to customer specifications—that are far ahead in the field. Materials used include Inconel X, A-286, 17-7PH, L-605 and others.

Specialized Solar-built ducting test facilities duplicate severe demands of today's advanced aircraft and missiles. Production is carried out under rigid standards of quality control. Many Solar-designed machines—built to save time and materials in intricate operations—help reduce costs and speed output. Leading aircraft for which Solar has designed or built ducting include the F-102, F-106, C-130, KC-135, A3J, F4H, 707 and X-15.

Complete design and engineering responsibility, specialized test equipment, and complete facilities for top-quality production are only three of the reasons why Solar is the logical choice to help step-up your important ducting program. For detailed information write to Dept. F-91, Solar Aircraft Company, San Diego 12, California.

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ENGINEERS WANTED! *Challenging projects, unlimited opportunities with Solar. Write today!*

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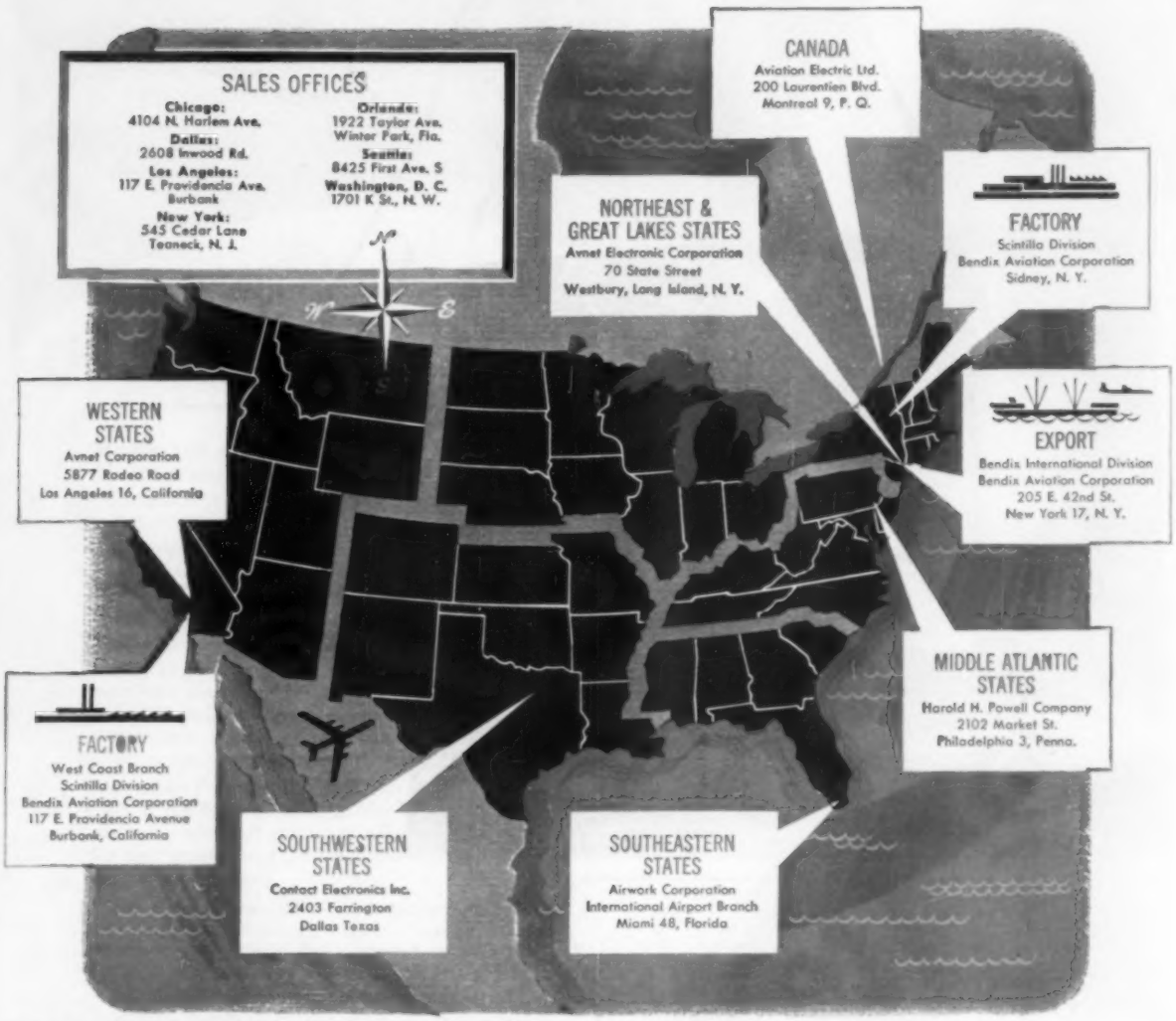

Large inventories of Bendix Electrical Connectors are now strategically located to assure you rapid delivery, regardless of your requirements or your location.

Each distribution center is factory-approved and inspected, and is stocked with connectors and components in an exceptionally wide range of types and sizes. Assembly and quality control facilities are maintained in complete accordance with factory standards and recommendations. Their staffs are adequate to assure not only immediate service but also reliable, efficient shipment of your order.

This expanded distribution system, combined with our greatly enlarged factory production facilities, makes available to all users the important advancements in engineering and design for which Bendix Electrical Connectors are favorably known.

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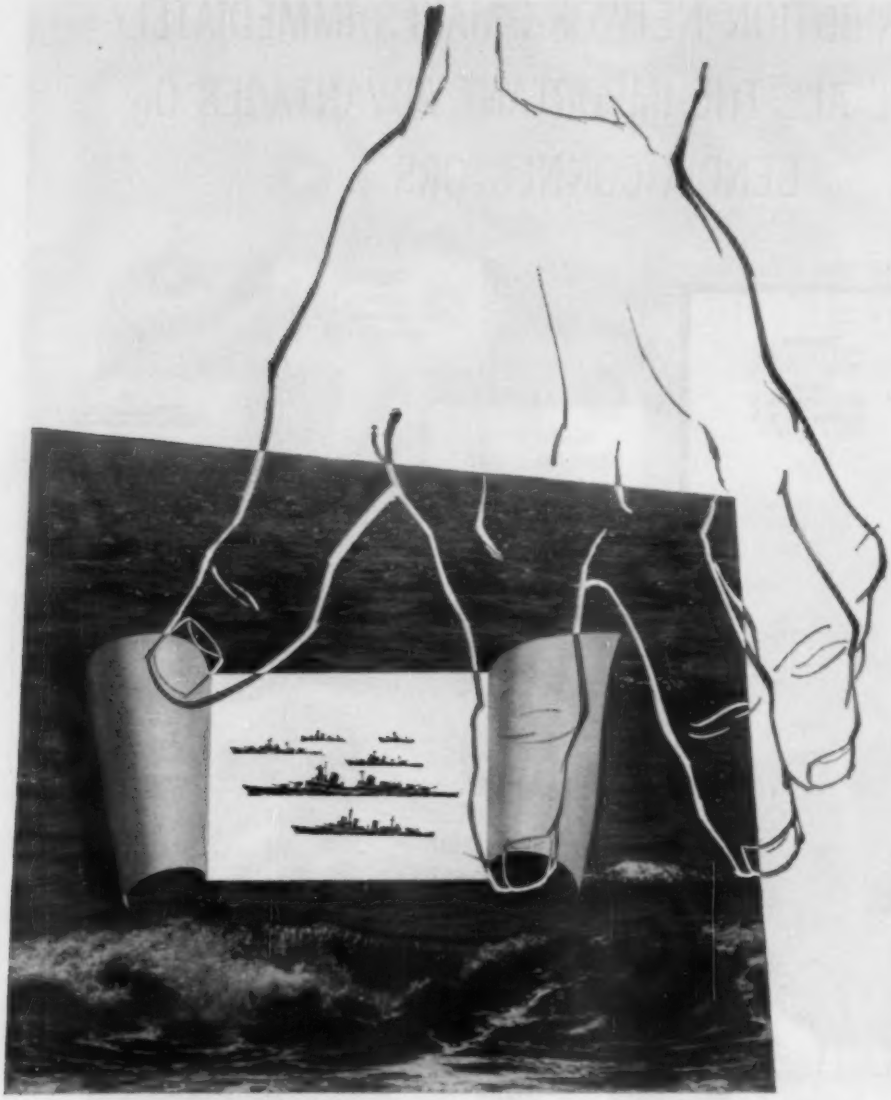

IR

Today the Singer Manufacturing Company's Military Products Division is performing a substantial role in basic research and development, engineering and production of infrared systems and components. This is just one of many ways in which the Military Products Division—composed of H.R.B., Inc., Diehl Manufacturing Company, and Bridgeport—is now serving national defense. Write for complete details.

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Modern high speed flight has cleared the sound barrier . . . penetrated the thermal thicket. Advanced turbojets, rockets and ramjets are producing unbelievable bursts of power.

The problem: HEAT . . . heat so intense that most metals can't withstand prolonged stress.

The solution: INCONEL family . . . because Inconel wrought alloys can withstand extreme stresses in high temperature aeronautical applications.

Canadian Steel Improvement Limited has pioneered many new developments in precision-forged Inconel parts for modern aircraft. By producing Inconel parts to extremely close tolerances with an excellent surface finish, machining time is greatly reduced.

The result: Precision-forged blades and close-to-form discs of the finest possible quality at the lowest possible cost consistent with maximum stress-rupture properties for high temperature service in modern high thrust gas turbine engines.

For complete information about Inconel parts for aeronautical applications, consult Canadian Steel Improvement Limited, 289 Horner Avenue, Toronto 14, Canada or their representative,

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CSI

CANADIAN STEEL IMPROVEMENT LIMITED

289 Horner Avenue, Toronto, Canada

big coupling for hot tailpipes

. . . high-temperature ducts and missile applications

Janitrol's new lightweight, non-torquing line of large diameter couplings provides a safe, easy to connect or disconnect, vibration-proof seal. They are simple to install, clamp together without need of a torque wrench, and assure positive alignment. Clamp latch cannot be closed unless pipe sections are correctly oriented. Total weight of the 36″ diameter clamp and two flanges is only 9.7 pounds. Clamp diameter adjusts to meet pipe production tolerances; a safety lock pin gives extra protection.

Test data: Model illustrated is tested to 15G's with tail pipe attached, and at temperatures to 900°F. Vibration requirements of MIL-E-5272A are met.

Janitrol couplings are supplied in stainless steel, with flanges of titanium, aluminum, or steel, in a wide range of sizes down to 1″ in diameter.

When you require high performance couplings for tail pipes or ductwork see your Janitrol representative.

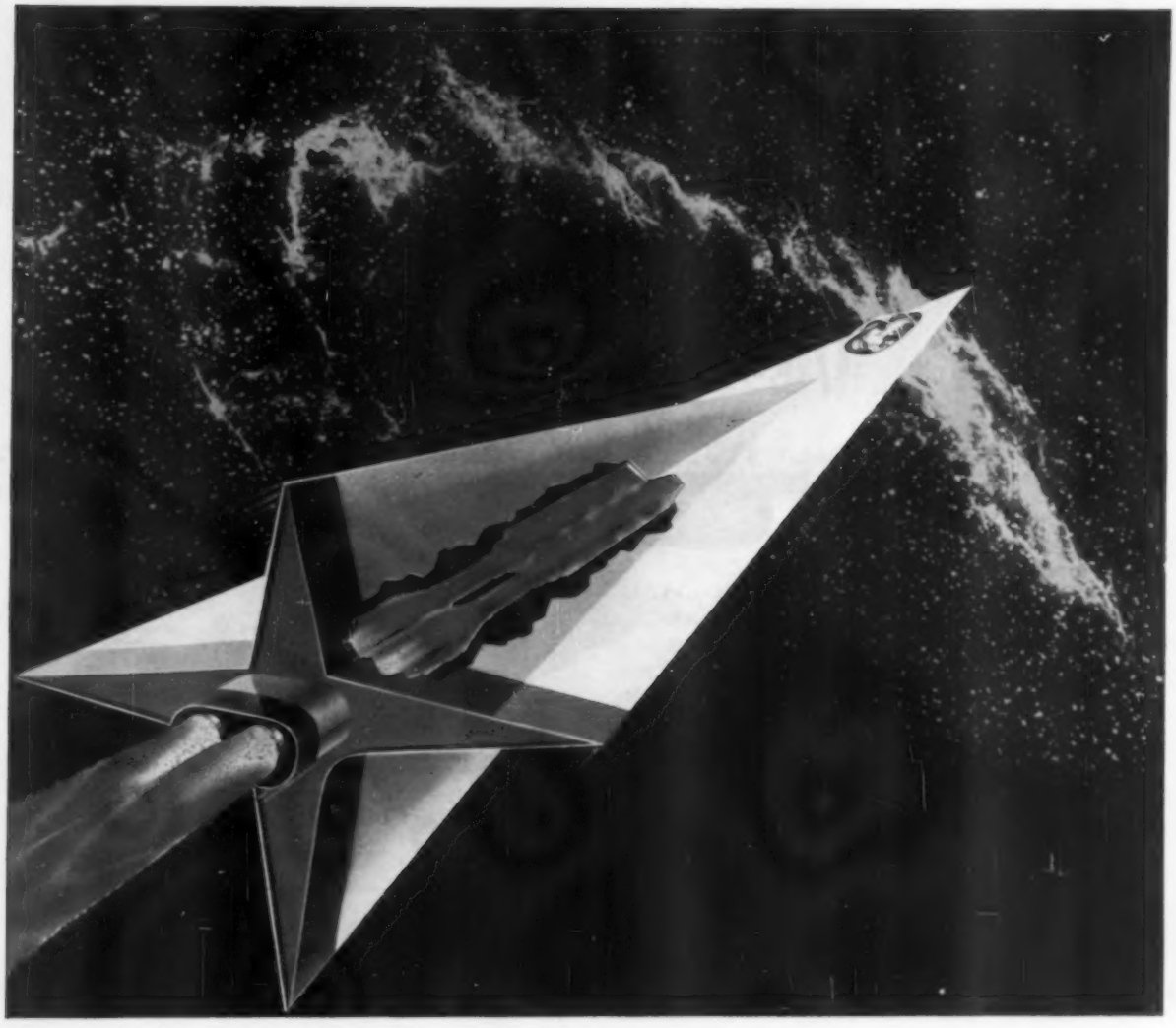
Janitrol Aircraft Division, Surface Combustion Corporation, Columbus 4, Ohio.

schematic cross-section of standard coupling

schematic cross-section of flush coupling

JANITROL

pneumatic controls • duct couplings & supports • heat exchangers
combustion equipment for aircraft, missiles, ground support



Baby, it's HOT inside .....

● Typical of Rollway R & D work is this hydraulic control bearing for the McDonnell "Voodoo" jet, featuring a broached, non-separable inner race.

No matter where it comes from . . . ultra-high angular velocities, skin-friction, conduction or radiation from the burners . . . today's airborne bearings spin in temperatures that approach ever closer to the softening point of conventional steels.

Unceasing research work here at Rollway strives for new understanding and control of limiting forces . . . and for practical metallurgical combinations that will enable aerodyne engines to fly faster, higher and further with less mechanical friction drag.

Rollway service extends all the way from down-to-earth estimates of lead time to closely-held schedules of delivery dates. Maybe we have what you want now on test. Costs nothing to find out. Just write or wire Rollway Bearing Co., Inc., 582 Seymour St., Syracuse 4, N. Y.

ROLLWAY®
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COMPLETE LINE OF RADIAL AND THRUST CYLINDRICAL ROLLER BEARINGS

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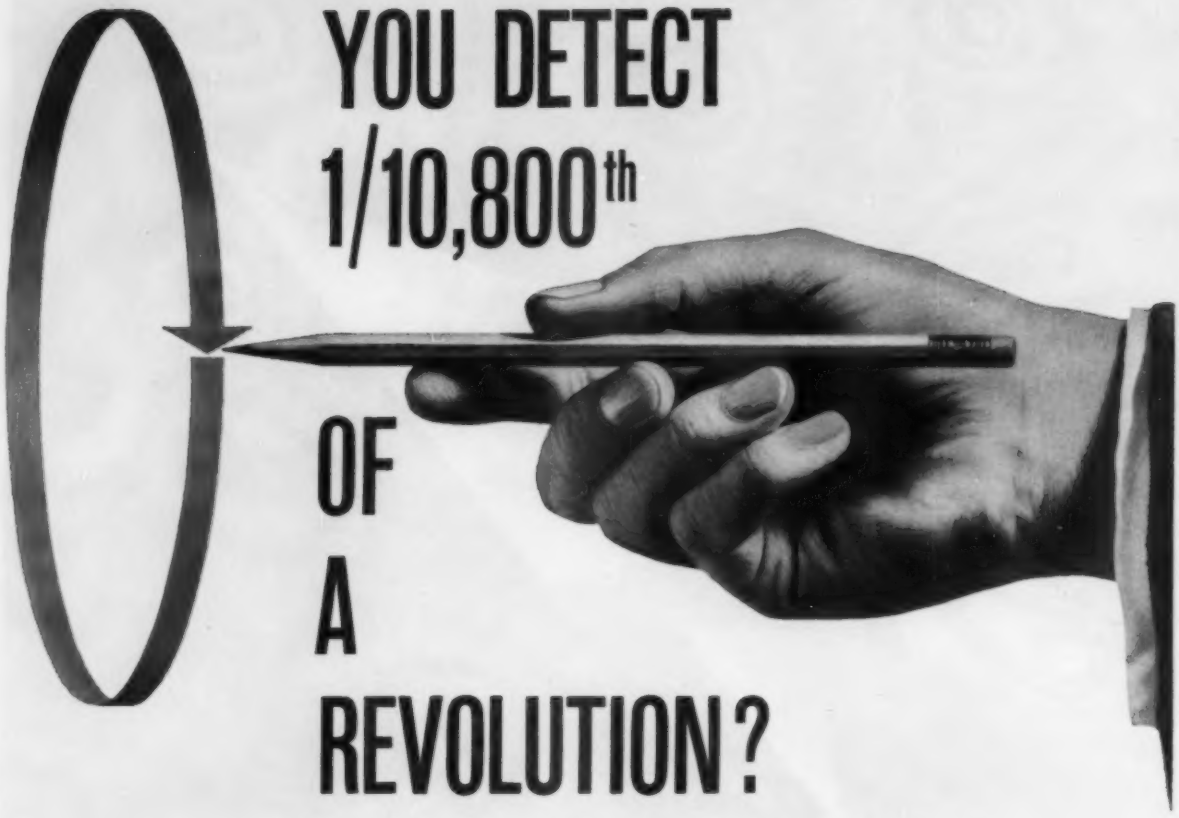
COULD YOU DETECT 1/10,800th OF A REVOLUTION?



Detecting microscopic shaft movement of as little as 2 minutes —well beyond the ability of most standard synchro units— can now be accomplished with new synchros designed and produced by Ketay, and available for immediate delivery. Such increased accuracy, three times better than the highest Mil Spec requirements, is the result of Ketay design and production competence.

Ketay has also developed a complete line of improved thru-bore synchros to the new Mil Spec 20708 (supersedes Mil Spec 16892). These improved units are available at no increase in cost in a full line of control and torque types, with frame sizes from 08 to 23. Thru-bore construction and stainless steel housing make them more rugged and more reliable as well as providing better accuracy and greater stability. *Ketay is the only approved Bureau of Ordnance source currently manufacturing and shipping all these units.*

Ketay research and development engineers are regularly working on advanced new components and prototype control system problems for the armed forces and leaders in the aircraft and missile industry. Let them help solve your special problems in component performance and environment adaptability.

Ketay precision components:

SYNCHROS
RESOLVERS
POTENTIOMETERS
SERVOMOTORS
TACHOMETERS
SERVO AMPLIFIERS
GYROMECHANISMS

Catalogues available.

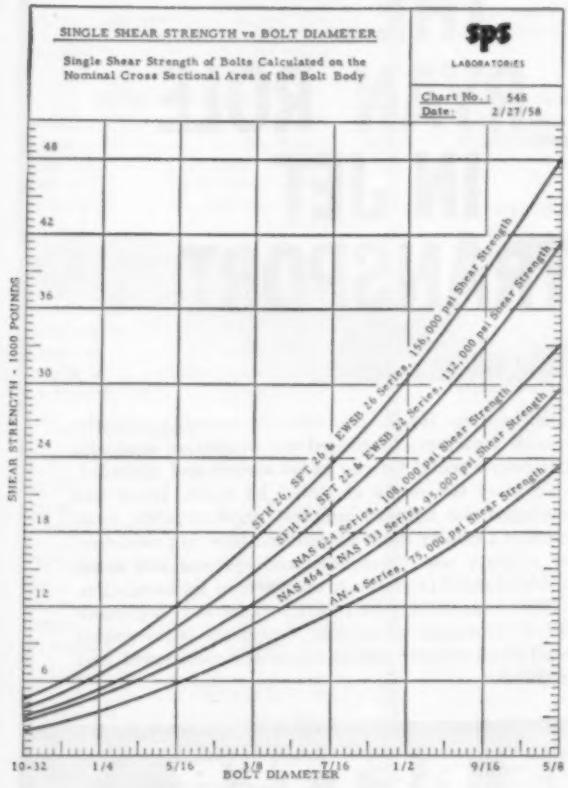
*** NORDEN * DIVISION of United Aircraft Corporation**

KETAY DEPARTMENT, Commack, Long Island, N.Y.

New SPS super high strength shear fasteners save you 25-50% in shear bolt weight

132,000 and 156,000 psi units are strongest standard shear fasteners ever offered

New SPS super bolts and companion locknuts are the strongest shear fasteners ever offered the aircraft-missiles industry, permit significant reductions in size and weight of threaded joints. Three different wrenching configurations are available, any one of which will induce over 50% of ultimate fastener strength. Units are serviceable to 550°F.



Greater shear strength. Graph shows shear strength in pounds for various diameter sizes of different shear bolts. Top two curves plot the new SPS super high strength shear bolts, available in 132,000 and 156,000 psi series. Remaining curves represent current aircraft industry standards.

These new SPS shear bolts are 39 to 64% stronger than the best standard shear fasteners now in use. They automatically save you 25 to 50% in shear bolt weight, because they can be substituted for conventional fasteners one to two diameter sizes larger... with no compromise in reliability.

For example, one of the new ½ in. diameter, 156,000 psi shear bolts, capable of design loading of 30,000 lb., does the structural job of a ⅝ in. NAS type weighing nearly 30% more. On a large airframe this can mean a saving of several hundred pounds. Further, the use of smaller fasteners often permits miniaturization of related parts in a joint, resulting in additional weight savings.

The new bolts are forged from 5% chrome high strength steel, then heat treated to 220,000 psi tensile for the 132,000 psi shear series and to 260,000 psi tensile for the 156,000 psi. Both series are available in standard sizes #10-32 through ⅜-18, with companion locknuts of new design. The 132,000 psi shear bolts have a cadmium-fluoborate plating, the 156,000 are vacuum cadmium plated. For complete information, write Aircraft/Missiles Division, STANDARD PRESSED STEEL Co., Jenkintown 3, Pa.

HIGH RELIABILITY

SPS research is continually developing fasteners with higher standards of predictable performance. By installing SPS high-reliability fasteners in your assemblies, you increase overall product reliability.

For more information on the full meaning of reliability, write for a copy of the new SPS booklet "High Reliability."

We also manufacture precision titanium fasteners / write for free booklet

SPS Jenkintown • Pennsylvania

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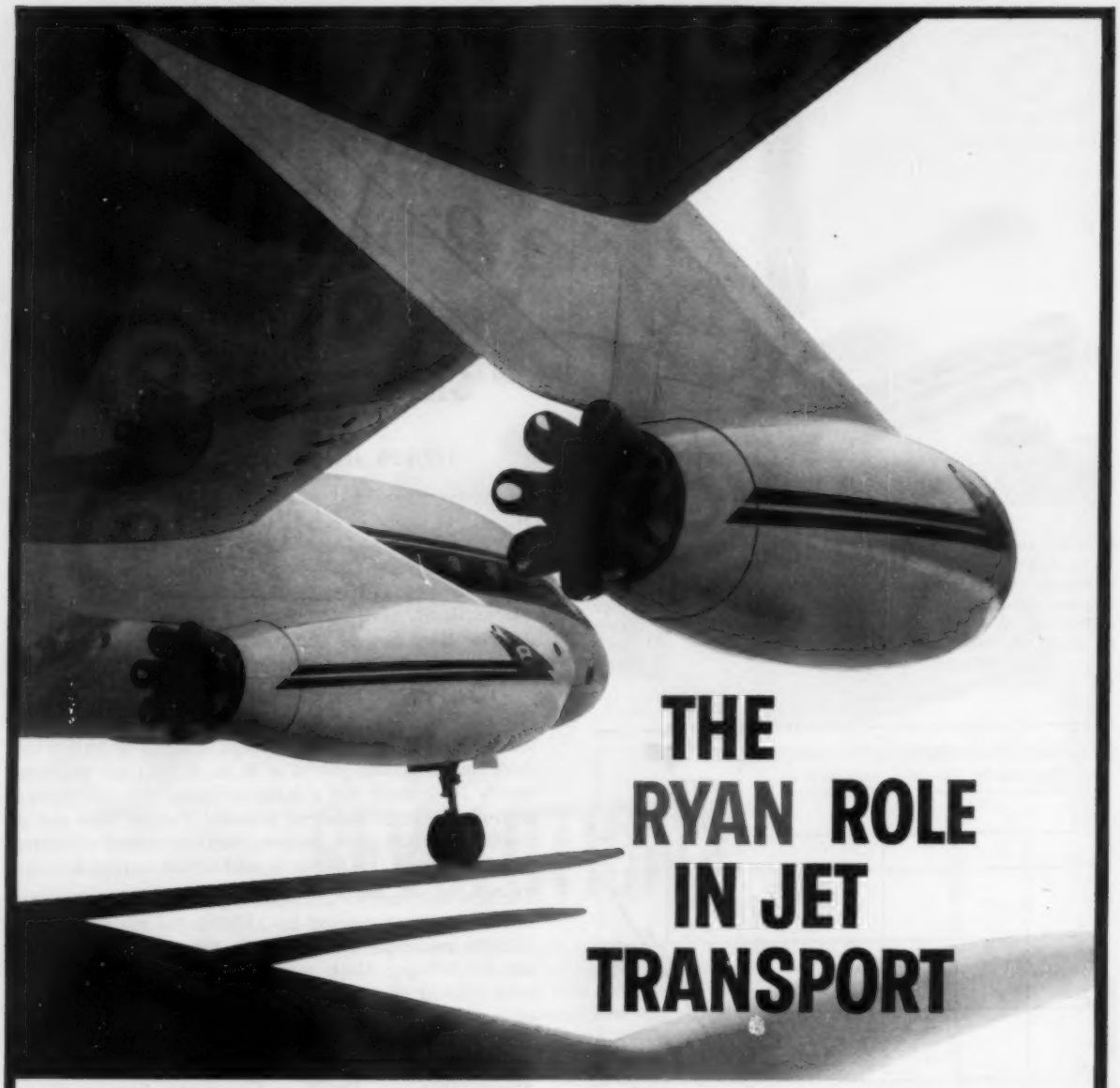

THE RYAN ROLE IN JET TRANSPORT

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November 24, 1958

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PICTURE CREDITS

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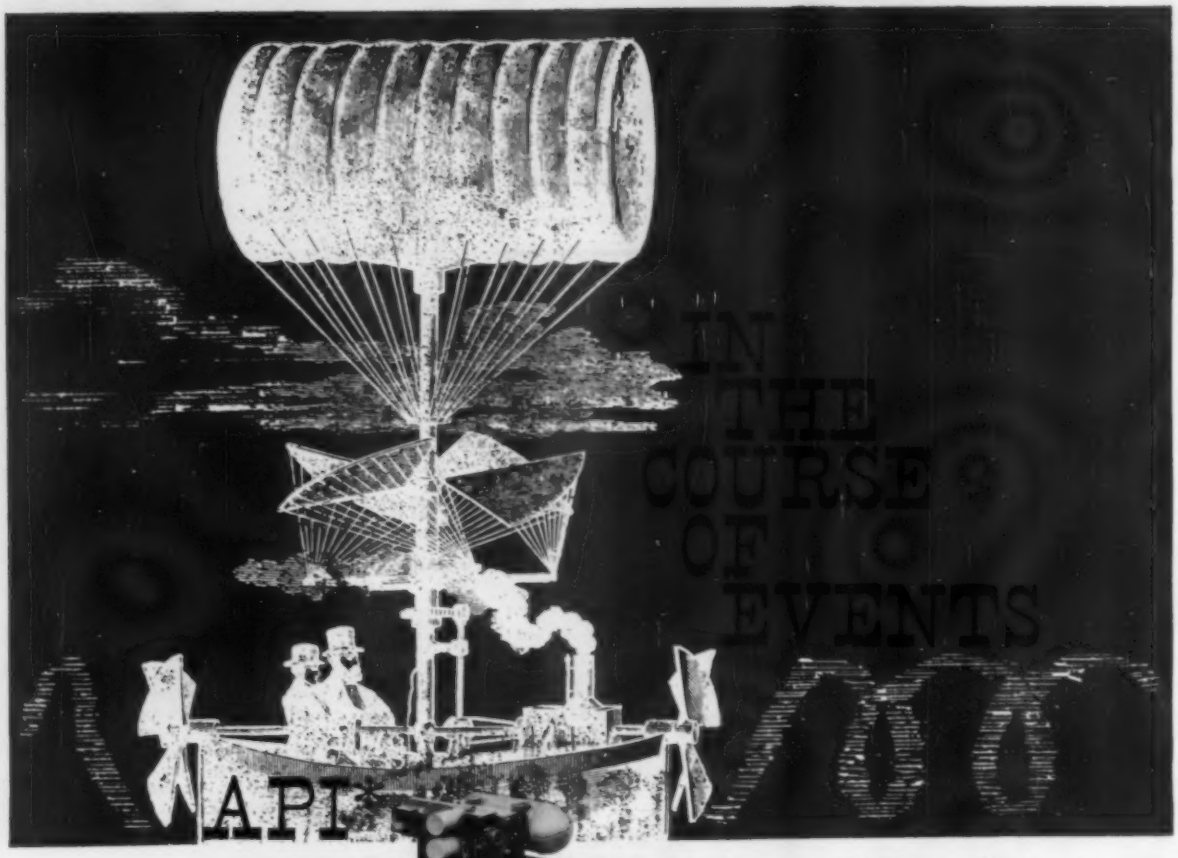

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EDITORIAL

The Need to Know

The battle of the defense budget, which never really ends, is mounting toward its annual crescendo climaxed by the prospect of debate and final action by a Congress overwhelmingly controlled by a political party in opposition to the executive branch of the government. Mr. Neil McElroy, who has made an excellent record during his initial year as Secretary of Defense, faces perhaps the toughest job he has yet tackled in this office. The 170 million citizens of this country and the citizens of our allies all around the world will be vitally concerned with this battle of the military Fiscal 1960 budget that is now being fought in the corridors of the Pentagon and the ancient architectural monstrosity that now houses most of the executive offices of the President's staff. In January the battle terrain will shift to Capitol Hill where the decisive maneuvers must be made.

It is already clear that the primary consideration of the executive branch of the government is in holding a fiscal ceiling rather than maintaining the defense posture and technical pace that leadership of the free world requires.

"Affording" Survival

We have never been able to understand the philosophy of those who stoutly maintain that this country cannot "afford" the expenditures that are required for adequate military strength and technical development of new weapons. Nor have we ever understood the process by which the budgeteers can pick a number and say "this is the absolute maximum we can afford to spend on defense." We saw this supposedly "absolute budget limitation" begin with the $15 billion annually which President Eisenhower, then military budget adviser to a Democratic administration, assured the country was the absolute limit it could "afford" for defense in the very year before Communists struck south across the 38th parallel in Korea. The life and death struggle of communism against the United Nations of the free world in Korea soon proved that we could not only "afford" more than $15 billion annually for defense of our country and our ideals but that expenditures triple and quadruple this supposedly "absolute limit" were required for survival.

During the post-Korean era there was naturally a concerted effort to bring the military budget well below its "hot war" level and certainly this was in order. But while this process was taking place we again saw the emergence of the budgeteers who came up with an "absolute ceiling," this time more than double the absolute ceiling set by President Eisenhower in 1950. Contrasted with this strictly budgetary view of defense problems is that of the military services who view the matter primarily from the viewpoint of their ability to perform the combat roles and missions they are assigned or would like to be assigned. Both views leave something to be desired in achieving the taxpayer's goal of a superior defense at the lowest possible cost.

In recent years it has been the sharp pencil budgeteers who have prevailed over the military requirement advocates and it appears that this situation still prevails in Fiscal 1960 defense budget preparations. There is also a growing effort to gag and muzzle the military men to prevent them from explaining their case adequately to the Congress and American public. In the execution of military policy absolute obedience to orders is required. But in the formulation of this policy, which is vital to every citizen of this land, it appears to be contrary to the basic democratic process of government to which this country is dedicated to deprive the people of the right to listen to honest views of their military leaders without restraint or fear of professional reprisals.

There has been a strong trend under both Republican and Democratic administrations during the post-war period to make available to the citizens of this country less and less information on the basic issues that shape the future of the world.

Information Holdout

That trend has never been stronger than it is today. Never have there been more men in high places in the executive branch of the government devoted more strongly to withholding information from the public on vital government business, tinting the information they do release to their own rosy glow and proclaiming the policy that the American public has no "need to know" about how its tax dollars are being spent or how its future is being shaped.

If the American people are ever to really understand such complex and vital matters as the defense budget battles and the technological race for new weapons development they must be given more basic information by their elected and appointed leaders.

—Robert Hotz

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WHO'S WHERE

In the Front Office

Harding L. Lawrence succeeds **Clarence C. West, Jr.**, retired, as executive vice president of Continental Air Lines, Inc.

Raymond F. Kelley, board chairman and president of Dynamics Corporation of America, New York, N. Y., and also of Reeves Instrument Corp., Garden City, N. Y., a subsidiary of Dynamics Corp.

Prof. Joseph M. Pettit, dean of the Stanford University School of Engineering, a director, Levinthal Electronic Products, Inc., Palo Alto, Calif.

Milton Greenberg, president of the newly formed Geophysics Corporation of America, Boston, Mass. Directors of the company are: **Mr. Greenberg; Richard S. Leghorn**, president of Itek Corp., and **T. F. Walkowicz**, associate of Laurance S. Rockefeller. Other officers are: **Murray Zelikoff**, vice president and director of research; **Robert Chapman**, vice president and director of engineering; **Ephraim Radner**, vice president-treasurer; **James E. Gallagher**, vice president and director of planning; **Richard D. Coons**, vice president and director of marketing.

Clark L. Hastings, president, Rochester Manufacturing Co., Rochester, N. Y.

Albert F. W. Parr, a vice president and director, engineering department of Powertronic Systems, Inc., a new subsidiary of Hydra-Power Corp., New Rochelle, N. Y.

International Electric Corp., Paramus, N. J., International Telephone and Telegraph Corp.'s newly formed unit to manage the production of a world-wide electronic control system for the Strategic Air Command, has elected the following vice presidents: **Robert W. Hughes** for engineering services; **John E. Kahelin** for customer relations and project control; **Charles G. Sherwood** for manufacturing and sub-contractors.

Gareth W. Speer, vice president-finance, Solar Aircraft Co., San Diego, Calif.

Honors and Elections

George F. Metcalf, General Electric's regional vice president, Washington Defense Activities, has been named chairman of the Aircraft Industries Assn.'s Guided Missiles Committee.

Joseph E. Morley, of A. V. Roe Canada Ltd., has been elected president of Air Industries & Transport Assn. of Canada.

The International Air Transport Assn. has elected **H. B. Renwick**, vice president of Canadian Pacific Air Lines, and **V. H. L. Dubourcq**, vice president of KLM Royal Dutch Airlines, chairmen of the 1959 Joint Traffic Conferences. Mr. Dubourcq will preside over the Spring Conference, set for mid-May in Europe, and Mr. Renwick will preside over the Fall meeting at Honolulu.

Charles H. Townes, Professor of Physics at Columbia University, and **Nicolaas Bloembergen**, Gordon McKay Professor of Applied Physics at Harvard University, have been named by the Institute of Radio Engineers to jointly receive The Morris Liebmann Memorial Prize "for fundamental and original contributions to the Maser."

(Continued on page 118)

INDUSTRY OBSERVER

► Air Force is investigating a promising technique for transmitting a modest amount of electric power to reconnaissance satellites by means of huge earth-based antennas and extremely high power transmitters.

► **Pratt & Whitney J58 and General Electric J93 turbojet engines, both under consideration for North American Aviation's Mach 3 B-70 bomber and F-108 interceptor (AW Nov. 7, p. 27), have airflow capacities of about 300 and 250 lb. per sec. respectively. General Electric's J93, specifically tailored for the two aircraft, is lighter and smaller than the J58, has about the same specific fuel consumption as the Pratt & Whitney engine which was originally developed under Navy cognizance.**

► Proposal to build the world's largest antenna, measuring perhaps 1,000 ft. in diameter, to measure electron density of space out to millions of miles and to bounce signals off planets has been proposed by General Electric and Cornell University to the Air Force and Advanced Research Projects Agency. If funding is authorized, the antenna will be constructed by scooping a parabolic-shaped hole in the ground and installing suitable mesh reflecting surface. Two sites have been proposed: suitably shaped areas in Puerto Rico and Laredo, Tex., where Air Force already has a high power radar transmitter installed.

► **In efforts to obtain Defense Department approval for development of the Eagle air-to-air missile, Navy is emphasizing Eagle's active radar guidance that would enable such a missile to be directed at a different target in a widely dispersed attack. Air Forces' GAR-9, being developed by Hughes Aircraft, which some Defense officials are suggesting as substitute for Eagle, uses semi-active radar guidance which requires the interceptor to keep its radar aimed at target until the missile strikes, making it better suited to a single-shot supersonic interceptor rather than for Navy's planned "slow-plane" missile platform aircraft (AW Nov. 10, p. 28).**

► General Electric J79 turbojet engine, fitted with a modified afterburner which burned HEF-3 exotic fuel, was recently tested at Edwards AFB, Calif., in the first of a series of basic fuel trials in the North American B-70 and F-108 development programs. Fuel rates will be boosted successively in subsequent tests.

► **Air Research & Development Command will soon announce a $7 million contract for exploratory development of "molecular electronics"—an entirely new solid-state element capable of performing functions that now require many individual interconnected components (AW June 2, p. 64; June 16, p. 243). Companies prominently mentioned among possible contractors include Bell Telephone Laboratories, Hughes Aircraft, Radio Corp. of America and Sprague Electric.**

► Airborne Early Warning and Control System selected by Air Force in its AEW competition (AW Nov. 17, p. 23) will be equipped to control interceptor missiles as well as fighters by direct data link communications when the interceptor is within range of the early warning plane's avionics. When out of range, intercept directions will be sent to ground station and relayed by data link to the interceptor.

► **Walter Kidde & Co. has developed filament-wound radomes fabricated from Fiberglas strands wound in layers. Radomes are about 80% glass. Material is designated ECG-150-1/0. Kidde has developed a 14-ft.-long one-piece ogival radome for a Mach 3 fighter, probably the F-108. Kidde also has developed 13-14 ft. radomes for missile applications. Material also is being used for making main solid propellant cylinders for rocket engines.**

► Army flight trials at Ft. Bliss, Tex., of Radioplane's RP-77D turboprop-powered Fiberglas target drone are aimed at reaching altitudes of above 40,000 ft. Flights already have extended beyond one hour. Speeds attained have been approximately 340 kt. Powerplant is a Boeing 502-10F turboprop engine producing 300 eshp.

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Washington Roundup

NASA Man-in-Space Committee

National Aeronautics and Space Administration last week announced formation of a Special Committee on Life Sciences to work with human factors, medical and allied problems of NASA's Man-in-Space program.

The committee, which probably will have the task of selecting the first man to be put into space in the NASA program, will be headed by Dr. W. Randolph Lovelace II, an authority on aeronautical and space medicine and president of the Lovelace Foundation for Medical Education and Research, Albuquerque, N. M.

At the same time, NASA announced that 13 new research advisory committees are being formed to provide technical counsel and aid NASA in communicating and coordinating its programs with industry, universities and other government organizations.

The committees also will review research in progress and recommend problems and should be investigated by NASA or other agencies.

Projects assigned the committees are fluid mechanics; aircraft aerodynamics; missile and space craft aerodynamics; control, guidance and navigation; chemical energy processes; nuclear energy; mechanical powerplant systems; electrical powerplant systems; structural loads; structural design; structural dynamics; materials, and aircraft operating problems.

The new committees, all of which will report directly to NASA Administrator T. Keith Glennan, are scheduled to be functioning by early next year and will supersede the 28 technical committees and subcommittees of the National Advisory Committee for Aeronautics, which was absorbed by NASA upon its establishment on Oct. 1.

AIA: Name Change Postponed

Aircraft Industries Assn. board of governors last week postponed any decision on proposals to change the name of the organization in order to reflect the changing character of the aviation business. The board also ruled out a recommendation that an outside public relations firm be called in to develop a new name (AW Oct. 28, p. 25) and asked Hill and Knowlton, Inc., AIA public relations counsel, to propose possible new names for the organization, plus pro and con reasons for any change, at the board's meeting next spring in Williamsburg, Va.

Contractors' Costs

Defense Department is still formally sticking to its Dec. 31 deadline for issuance of a comprehensive new set of cost principles for all military contracts, except competitive bids, but it's doubtful if it will make it. More likely, a partial set of the less provocative proposals will be issued first, and additions made step by step.

Trade associations, including the Aircraft Industries Assn., Electronics Industry Assn. and the National Security Industrial Assn., are unanimously opposed to all but a few of the cost principles tentatively planned by Defense Department. They have been in negotiation for nine months. In a "last protest," industry spokesmen told Perkins McGuire, Assistant Secretary of Defense for Supply and Logistics, that "a complete review of the proposals outstanding are essential."

They also declared that the new principles are of "the utmost gravity, as they affect the cost recoveries and profit potentials of every company engaged in defense contracting—not, as in the past, just those which undertake cost reimbursement type contracts. . . . If made applicable to current contracts to any extent, the regulations, as proposed, would materially revise the basis under which every present contractor agreed to perform his obligations."

The industry spokesmen urged McGuire to confine the Defense directive to a general statement of "policies and principles"—and leave detailed interpretations and instructions to an "auditors' manual."

Douglas: More Secrecy

Air Force Secretary James Douglas says he believes in tightening the security clamps on military information. "I think we are unwise in being as liberal as we are in the release of information," Douglas told the House Government Information Subcommittee. "There is no such enthusiasm in Russia."

Procurement Policy

Keen interest has developed in legislation that could revolutionize military procurement policy. The legislation was introduced by Sen. Leverett Saltonstall (R.-Mass.) at the close of this year's congressional session (AW Aug. 18 p. 26). Among its other provisions, the measure would establish "performance" contracts, eliminating detailed specifications, and exempt incentive and fixed price contracts from renegotiations. Department of Defense has appointed a task force under Assistant Secretary of Defense Perkins McGuire to make a comprehensive study. National Security Industrial Assn. and U.S. Chamber of Commerce have appointed study groups. The Chamber will consider the proposal at its annual meeting in January.

Government Plants

House Armed Services Investigating Subcommittee headed by Rep. Edward Hebert will hold hearings Dec. 3 on complaints that the military services are financing private plant facilities for weapons that could be produced in now-closed government-owned facilities. Witness will include Frank H. Higgins, Assistant Secretary of the Army; Fred A. Bantz, Assistant Secretary of Navy; Dudley Sharp, Assistant Secretary of the Air Force for Materiel, and Floyd Bryant, Assistant Secretary of Defense.

Lobbying Charge

Testimony last week by James Landis, former Civil Aeronautics Board chairman, at a hearing of the House Legislative Oversight Committee, is expected to give a boost to proposed legislation limiting Presidential review of international route cases to purely foreign policy and defense considerations. The Senate passed such legislation in the last Congress, despite vigorous White House opposition, but the bill died in the House. Although CAB decisions are supposed to be confidential, Landis told the House group, that they generally become known and that airline lobbying activities are concentrated on the White House. "No one then knows who sees whom on the White House staff or what evidence is presented. . . . The procedure places a premium on lobbying in its worst characteristics."

—Washington staff

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Space Technology

ARPA Reveals Rocket Satellite Programs

Objectives described by Johnson indicate extent to which U. S. has projected its military space program.

By Evert Clark

New York—Comprehensive military space program aimed at creating a family of powerful rocket boosters and orbiting a family of satellites in a very few years was outlined here last week by Roy W. Johnson, director of the Advanced Research Projects Agency.

Johnson's remarks before the 13th annual meeting of the American Rocket Society indicated that the U. S. is farther along in planning for the military aspects of space than has been generally believed. Other experts who discussed the nation's military and civilian space capabilities made it clear that most of that capability still is potential, rather than realized.

Meeting attracted attendance officially estimated at 7,000, including a number of new exhibitors and new corporate members. Johnson noted that many of the society's members had been in the space business "even before it made sense," and said he hoped they would not relax their efforts "now that it does make sense."

Johnson said his agency hopes to put a 6,000 lb. communications satellite in a "stationary" orbit 22,300 mi. out from the earth by late 1960, using a cluster of eight Jupiter engines plus an Atlas, Titan or possibly a Minuteman second stage.

The so-called "stationary" orbit is at such a distance from the earth that the satellite remains above one point on the earth's surface, because its period of rotation in its orbit is 24 hr.

Contract for the launching system, including the second stage, was granted to Army's Ballistic Missile Agency last September, one month after ARPA gave ABMA an order to develop the first-stage cluster.

Capability Study

At the moment, the project is being coordinated by Army Signal Corps for Johnson, but a panel is studying the services' capabilities, and Johnson said the tendency now is to lean toward Signal Corps for the payload and Air Force for the booster.

Jupiter cluster should be static-tested next summer and should produce about 1.3 million lb. of thrust, or 1.5 million with some modification to the engines, Johnson said.

This vehicle will be a "space truck" that could put a 25,000 lb. satellite into a very high orbit or provide the power capability to send a manned vehicle around the moon and possibly to land a vehicle there that was capable of returning to earth. But Johnson pointed out that "there is no military mission on the moon right now." He also said that although power capability for a manned lunar trip might exist by late 1960, he did not believe some of the other problems would be solved by then.

Johnson's agency, which began operation just over six months ago, has issued 40 work orders totaling $275 million. Most of these have gone to the services, who in turn write and monitor them for contracts with industry, universities, or government laboratories.

ARPA Program

Among the programs ARPA Johnson mentioned are:

• **Ballistic missile defense.** A $100 million program of basic research into all physical aspects of ballistic missile flight is under way. So far, $60 million has been committed and the other $40 million probably will be before the end of the year. This is a national program involving all three services, industry and universities. It is aimed at using all types of measuring methods—infrared, radar, visual, air pressure patterns, etc.—to determine all flight characteristics of a missile, how to distinguish a warhead from a decoy, how to destroy a warhead, and so on. "We might even be able to determine which type missile is flying by looking at its track," Johnson said. Construction of devices to study missile flight more carefully than before already has begun along the first 3,000 mi. of the Atlantic Missile Range that begins at Cape Canaveral, Fla. Meanwhile, work is going ahead on the Air Force Ballistic Missile Early Warning System and the Army Nike-Zeus anti-missile missile, which will be operating "in a few years," but Johnson said these are interim systems.

• **Early warning satellite.** Initially these would use infrared detection devices. Later, electromagnetic devices would be added. These could also be used for an international inspection system, Johnson said.

• **Navigation satellite.** Johnson gave no details but said work is under way.

• **Tactical cloud-cover satellite.** Again, Johnson did not go into detail, but there have been other indications that this also is a Signal Corps project.

• **Recoverable space vehicle system.** ARPA is already well along in developing this. It has "primary military applications in addition to man-in-space applications," he said.

• **High-energy second stage rocket.** This is the contract awarded to Pratt & Whitney Division of United Aircraft Corp. (AW Nov. 10, p. 26). Johnson said Atlas and Titan will put 4,000 lb. into a 300 mi. orbit with an Atlas or Titan plus this stage—which aims at 30,000 to 75,000 lb. of thrust—ARPA hopes to be able to put up a payload of four or five tons. Amount of the contract is believed to be $30 million. This vehicle could have a number of missions, but at the moment ARPA has no plans to launch a manned satellite with it.

• **Solid propellant** basic research program (AW Nov. 3, p. 34). This aims at specific impulses "well over 300," and will attempt to achieve these "by attacking basic chemistry, and creating new chemicals, so we can stop using the chemicals on the shelf." Johnson said solids "are the ultimate as far as I'm concerned." He said it may not even be necessary to build hard bases for ballistic missiles if solids come along fast enough. Storable liquid propellants "are progressing well enough without us so ARPA has no program on this," he said.

Rocket Bid Reopened

Johnson said the competition for a 1 million lb. thrust, single-chamber rocket engine—originally contracted by Air Force to Rocketdyne Division of North American Aviation, Inc. at ARPA's direction and later transferred to the National Aeronautics and Space Administration—has been reopened for bidding.

Precise Capsule Control

Washington—Ground control over manned satellites must be capable of returning the vehicle safely to the earth during all portions of its flight, according to the minimum requirements established by aero-medical experts associated with the Man-in-Space project. Medical consultants from the military services called in by the National Aeronautics and Space Administration feel that they must be capable of terminating the flight at any time the crewman begins to have physiological or psychological difficulty.

The reopening was done to allow companies to bid who were not in the rocket field when Air Research and Development Command held the earlier competition. These include Pratt & Whitney.

This single-chamber engine is a five to seven year development and might be used in clusters of 3 to 6.

He asked the Rocket Society to continue to "sell" the space field so public support of government programs would not flag. The worst thing that could happen now, he said, would be if Russia was inactive in space work for a time because the momentum gathered by the U. S. might diminish.

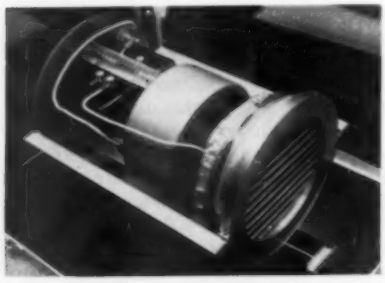
Dr. Hugh Dryden, deputy administrator of NASA, said both Army and Air Force will fire more space probes using Jupiter and Thor boosters. One probably will be an Air Force probe to study the radiation field, he said.

Among the determinations that must be made, probably with similar probes, is whether radiation intensity is less at the poles, whether it has a minimum altitude limit, and whether it varies with time, he said.

Two of the most immediate satellite projects for the civilian space agency are in the meteorological and communications fields, Dr. Dryden said.

Dr. Homer E. Newell, assistant director of NASA for space sciences, said that within the next 10 years the U. S. will have done "a considerable amount of exploration of the moon, Mars and Venus with unmanned probes, and in all likelihood deep space probes will have been sent well beyond that."

After that, the next step "is to plunge into study of the cosmologies, the origin of the universe," Newell said. Recent studies have discovered "very bright and very interesting ultraviolet stars," and have raised the question of whether there are X-ray and gamma-ray stars, he said.



Ion Rocket

Model of experimental ion rocket, which will be tested in North American Aviation's Rocketdyne Propulsion Field Laboratory early in January, marking first time actual hardware in this propulsion sphere is operated. Engine will be tested in vacuum and it is expected to deliver from 2/10th to ¼-lb. thrust.

Scientific Conservatism Blamed In Nuclear-Plane Project Delay

Washington—Financial timidity and "nearly continuous review by various scientific groups or committees" were blamed last week for delays in the 13-year-old U. S. program to develop a nuclear-powered aircraft.

Maj. Gen. Donald J. Keirn, Air Force assistant deputy chief of staff for development for nuclear weapons, said the program is "now on the threshold of success in the various technological areas." He indicated, however, that the project would have been much further along if it had not been for the scientific conservatism of some of its advisers.

In a speech at an American Ordnance Assn. meeting here, Gen. Keirn said much of the advice received from the scientific groups called in by the Air Force, Atomic Energy Commission and Department of Defense has been helpful but added:

"There also have been instances of advice which, while sincere, could have had broad impact on the program had we not been able subsequently to show that the advice was based on insufficient factual considerations."

Emphasizing that technical advancement of the program requires a "healthy concurrent hardware testing program" to take full advantage of existing knowledge, Gen. Keirn added, "This fact does not seem to be fully appreciated by some scientists who continually advise less effort on hardware development pending further achievements in improved materials."

Keirn, to back his charge that some of the scientific advice received, is based upon insufficient fact, outlined two examples of delays already experienced.

• **"Three or four years ago,** a group of eminent scientists concluded that chemically-powered aircraft will always be able to fly higher and faster than nuclear-powered aircraft. The conclusion was based on the following simple technical fact. By assuming similar structural and container materials in a propulsion device, it was reasoned that higher temperatures could be achieved in the propulsive media by burning chemical fuel in the media rather than by heating the media through the container walls, the wall temperature in each case being essentially the same.

"Subsequently, the Air Force was able to show that a nuclear powered system possessing speed and altitude capability comparable to chemical-powered counterparts could be achieved by augmenting the thrust from the basic nuclear powerplant through chemical afterburning during these periods when such performance would be required."

• **One major reason behind** "much of the pessimism which has pervaded the comments of some of our foremost scientific counselors" has been the low propulsive air temperatures which kept engine thrust-to-weight ratios very low. Actually, Keirn said, two methods of attack have always been open to improve engine efficiencies—development of new basic materials or improved heat exchanges. "Significant increases in system efficiencies" have been made, Keirn said, but added that "there is much more that can be done in this direction."

Keirn said he did not "wish these comments to be taken in a sense derogative to our many scientific advisors, but rather as a caution with regard to forming opinions or reaching conclusions on the basis of single technical facts taken out of context, so to speak, with all of the related facts which may have a profound bearing on the matter."

As examples of where cost played its part, Keirn said a program to flight test a nuclear propulsion system in a modified B-36 was cancelled in early 1953 "because the military potential of the airplane/powerplant system was extremely limited and the cost was not considered justifiable on the benefits of technical development alone."

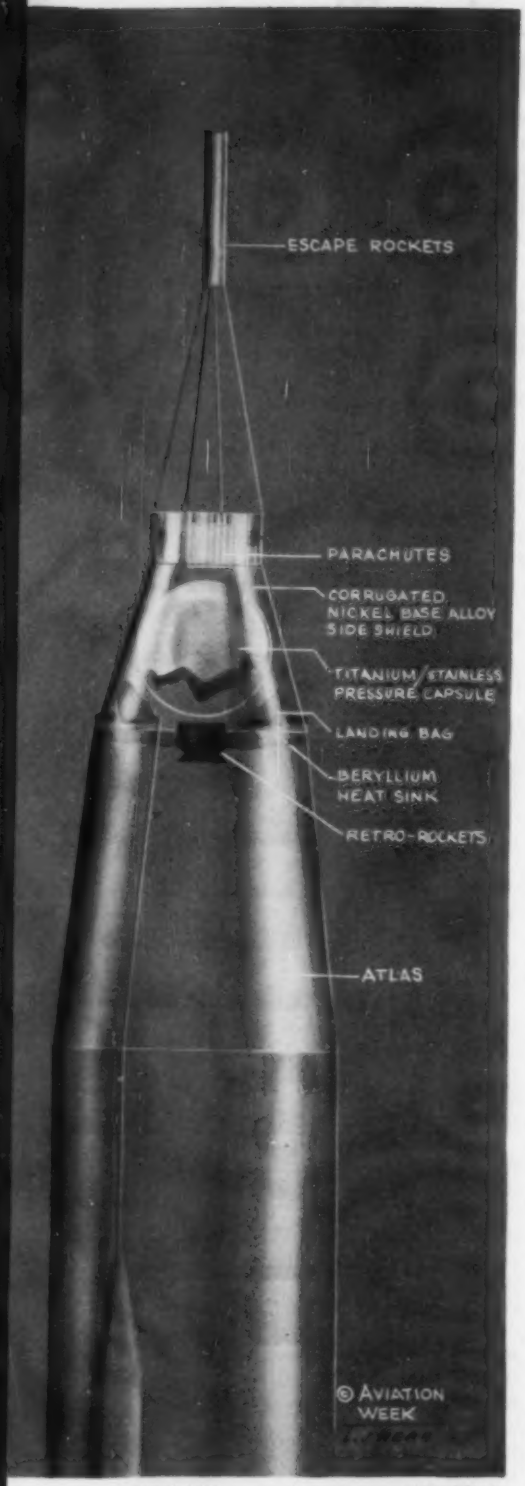
More recently—in late 1956—he said work on a supersonic bomber for the WS125A project "was reoriented because the technical risk of success was considered too severe to justify the high cost."

At present, Gen. Keirn said, the U. S. will "soon be ready to embark on an experimental flight development phase looking toward a prototype aircraft as the next logical step in the program."

He described the program as one that provides for "an orderly and sequential development program to achieve our objective of a militarily useful aircraft on a minimum time and cost basis by emphasizing safety, integrated powerplant and shield development and equipment proof testing." He added:

"It will not require major commitment of funds until powerplant reliability is established, ground handling and maintenance techniques developed and a reasonable amount of nuclear flight test time accomplished. Such a procedure is basically a 'fly before buy' approach."

One facet of the over-all program receiving renewed interest, according to Gen. Keirn, is a proposal for a nuclear turboprop configuration for transporting heavy payloads at speeds "somewhat lower" than that of a nuclear bomber or early warning aircraft.



ARTIST'S conception of a possible NASA capsule configuration assumes a spherical shape cockpit separated by heat and noise insulation from an outer side shield of a nickel base alloy. Beryllium heat sink is mounted on the bottom where the capsule attaches to the Atlas booster. It becomes front face in re-entry.

Space Technology

NASA Asks Specific Capsule

Washington—Specifications for the National Aeronautics and Space Administration Man-in-Space capsule are more detailed than is usual and restrict the contractor to a specific approach.

NASA said it was a deliberate policy in this case though not necessarily a guide as to its future specifications. "There are a lot of ways to skin this particular cat," an NASA spokesman said, "but we wanted to nail down precisely what we want."

Proposals are due Dec. 11, a week's postponement from the original date of Dec. 4 (AW Nov. 10, p. 27). NASA has not disclosed the unclassified specifications, but AVIATION WEEK has learned details of the assumptions made by NASA as a basis for feasibility studies. For example:

- **Beryllium heat sink** is proposed for front face heat protection during re-entry. Use of an ablation material is considered as an alternate, backup approach.
- **Shell construction** of titanium honeycomb sandwich or, alternatively, a welded semimonocoque shell (pressure vessel) of either titanium or stainless steel.
- **Side heat shields** constructed on a .010 in. thick longitudinally-corrugated nickel base alloy.
- **Interior heat and noise** shielding from a combination of the two metal walls and two layers of dual purpose insulation.

NASA specifies that the capsule shall have an extremely blunt forebody producing the maximum practicable wave drag and uniform surface heating. It must have no tendency to tumble in re-entry, even in recovery from extreme angles of attack.

The 2,400 lb. capsule is to be fired from Cape Canaveral, Fla., by an Atlas D booster into an orbit almost circular. This is to ensure as exact control as possible of the landing site. Apogee is to be 120 mi. and perigee 110 mi. with maximum eccentricity of .005.

Re-entry is to be initiated by ground control after two cycles, though the capsule is to be capable of up to 18 cycles.

Three solid propellant retrorockets, mounted on the capsule front ahead of the heat shield, will be fired simultaneously to produce a re-entry angle of ½-3 deg. to the flight path. Retro-impulse is to produce a velocity of 500 fps.

A drogue parachute, a fist ribbon type capable of operating at speeds up to Mach 1.5, will be deployed at 70,000 ft. at a speed of Mach 1. The primary parachute will be deployed at 10,000 ft. to produce a landing sink speed of 30 fps.

In the landing sequence the retrorockets are jettisoned after firing. After the heat sink has performed its mission, it also is dropped from the front face of the capsule and an inflatable landing bag, carried behind the shield, is inflated for actual impact.

Occupant of the capsule faces forward during firing and backwards in re-entry and landing.

NASA specifies the capsule, for purposes of description, as divided into three sections: a bottom on which the retrorockets and heat sink are mounted and which supports the internal equipment and which will be subject to water impact as is contemplated or to earth impact if necessary; a mid-section designed to accommodate an entrance hatch and viewing ports, and a top dome designed to accommodate parachute attachments and mounts for the solid propellant escape rocket systems.

The capsule must be capable of sustaining:

- **Rigid body accelerations** of 25Gs axially and 4Gs laterally.
- **Water impact** loading of approximately 15Gs.
- **Abort mission** loads of a maximum of 25Gs.
- **Internal pressures** on the pressure vessel of 15 psi. (Atmospheric pressure.)

Besides being leak resistant after water impact, the capsule must be resistant to meteorite damage during orbit to the extent that the pressure loss that would prove fatal would be less than .001 for a 28 hr. period. Equivalent of .01 in. of steel is regarded as sufficient for meteorite strike protection.

Temperature difference between the bottom, middle and top sections is anticipated by NASA at 300F. Maximum temperature of each section is to be held through heat shielding to 600F.

NASA assumes these heating and temperature ranges for re-entry:

- **Stagnation heating** of the front face at entry angles of ½-3 deg. indicates a duration as long as 500 sec. and maximum heating rates of 50-100 Btu/ft.^{2}
- **Total heat input** for the front face of about 8,000 Btu/ft.^{2} is associated with an entry angle of ½ deg. with lesser inputs for greater angles.
- **Afterbody radiation** equilibrium temperature on the side shields is estimated at 1,400F-1,600F. Total heat inputs on the side shields will be on the order of 1,000 Btu/ft^2. For these, the nickel base alloy use is suggested.

Two layers of insulation are assumed

Approach

for heat and noise reduction in the capsule interior. NASA estimates ½ lb./ft.² of dual purpose insulation should reduce the total heat transmitted to the capsule contents during re-entry to 25 Btu/ft.² of wall area. The combination of two metal walls and two insulation layers should be capable of providing a 30 db. reduction in noise at frequencies of 600 cps.

Visualizing these requirements as hardware might produce a vehicle on this order: a shell, probably a sphere, of Titanium or stainless steel for the occupant placed inside a cone open at both ends and constructed of the nickel base alloy. These two structures are separated by the layers of insulation. At the small end of the cone the parachutes are stored and the safety rocket pylons extend forward from this. At the large end of the cone the beryllium heat sink is attached, upon which the retrorockets are mounted.

The landing bag then would be stored between the heat sink and the interior shell.

Reaction jets, with one alternative exception, are specified for the stabilization and control systems.

The systems are broken down this way:

- **Automatic control system** which is divided into high and low torque modes. The high torque mode is to use reaction jets, but the low torque mode may use reaction jets or reaction wheels.
- **Manual control system** readily achieved from the pilot's normal restrained position. Mechanical linkages to mechanical valves which control the flow of the reaction jets are specified for the manual system.

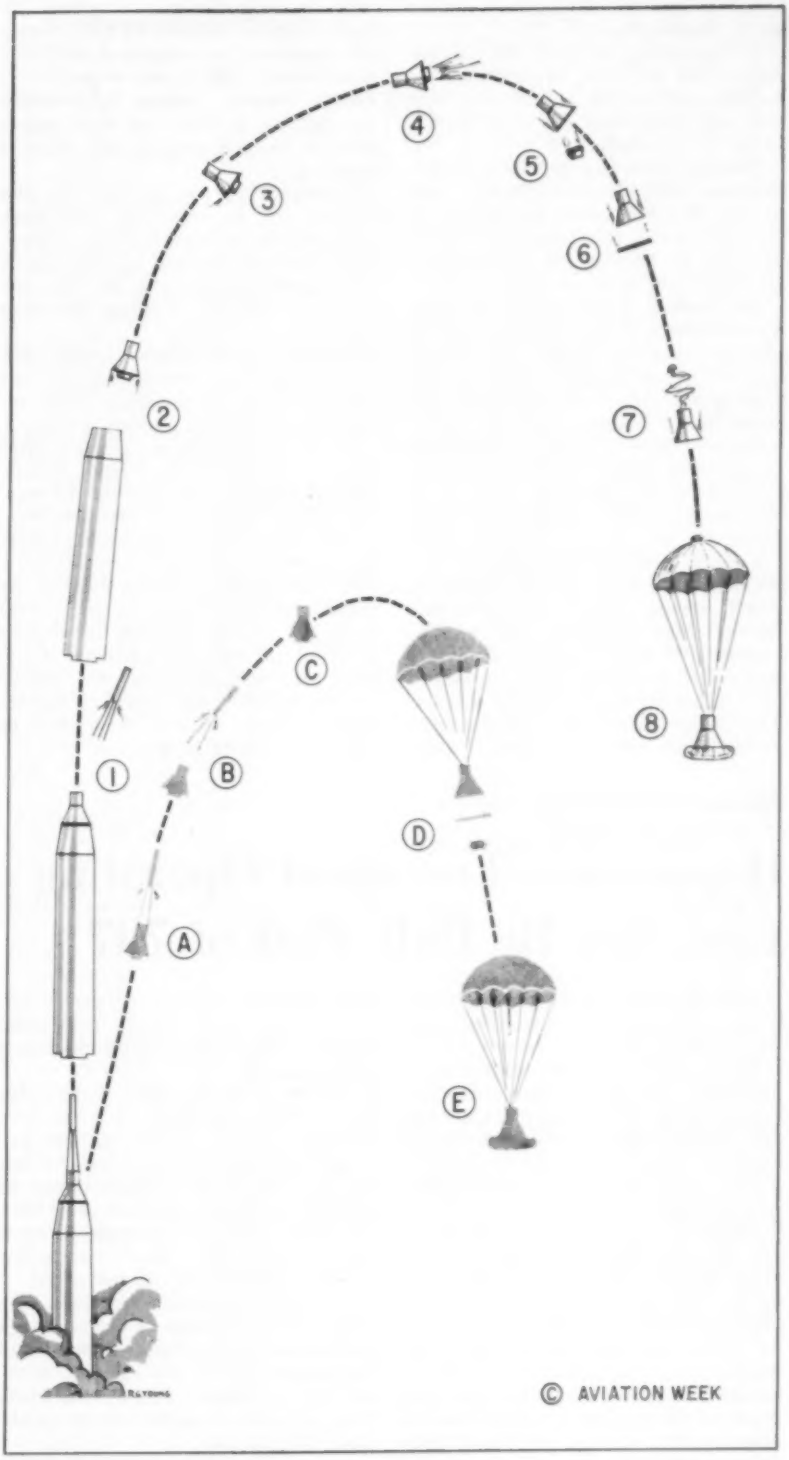
Alignment of the capsule is to be attained in orbit within three minutes after booster separation and the stabilization system is to have an accuracy of plus or minus five degrees about each of the three axes.

The high torque mode is used for:

- **Damping** of residual motion of the capsule after booster burnout and separation.
- **Stabilization** during firing of the retrorockets.
- **Damping** during entry.
- **Periods of high torque** requirements in case the low torque system becomes saturated.

The low torque system maintains three-axis control for the balance of the orbital and entry phases.

Normal missions call for jettisoning of the solid propellant escape rockets and pylon on which they are mounted five seconds after staging of the launch



NORMAL FLIGHT sequence and a pad abort of NASA's Man-in-Space capsule are visualized in this sketch. Numbered sequence shows normal flight, with (1) separation of escape rockets five seconds after staging; (2) capsule separation from the booster; (3) orienting of capsule for re-entry; (4) firing of retrorockets; (5) separation of retrorockets; (6-7) separation of heat sink and deployment of drogue parachute, and (8) streaming of landing parachute and inflation of landing bag. Letters show pad abort with (A) escape rockets firing the capsule upward and to the side of the booster; (B) escape rocket separation, and (C-D-E) carrying out of the landing sequence described above.

rocket system. Small auxiliary motors are to perform this task.

In launching attitude the escape rockets and pylon are forward and the bottom section of the capsule, with heat sink and retrorockets, fits onto the top of the Atlas launcher.

Should a launching pad abort occur—the most critical situation for the safety of the pilot—the safety rockets are to fire the capsule to a minimum height of 2,500 ft. Landing then would take place generally as in re-entry.

For landing, provision will be made for an additional parachute in case the primary parachute fails. The drogue parachute will incorporate a metallic coating for radar reflection and gore colors of the landing parachute will be alternately natural and international orange for maximum visibility. The capsule is to remain afloat at least 12 hr. after landing and be capable of 28 hr. in flight.

Capsule equipment includes:

• **Communications:** two-way voice; command receiver, ground to vehicle; telemetry, vehicle to ground; radio tracking beacon (108 mc.); rescue beacons (HF and UHF) and other recovery aids; S and X band beacons for the General Electric guidance system and the retrorocket firing command system; C-band radar tracking beacon; (tracking by Radio Corp. of America FPS-16 radars). GE guidance is adaptation of GE's Atlas system (AW April 28, p. 74).

• **High intensity** flashing light system for tracking. A silver zinc type battery resistant to immersion in salt water is specified.

• **Cameras:** two are specified for the interior, one to record the pilot's appearance, the other his instrument readings. Cameras also will be provided for photographing the earth and sky, including a 360 deg. horizon picture of the earth.

• **Medical measurements:** electrocardiogram; respiratory rate and depth; suit pressure; body temperature; voice recording; mental and physical activity.

Some experiments are planned prior to an orbital shot. These include limited mobility tests, tests of the manual control system, and the like.

Suborbital shots to duplicate re-entry and launch conditions are indicated. One example given for first flight of the capsule calls for a firing elevation of 80 deg., the capsule reaching an altitude of 99 mi. and traveling a distance of 200 mi. One exception to the usually specific details is the navigation system. NASA merely specifies there shall be one. No further suggestions.

Space Technology

Hypersonic Transport Operating Cost May Be Half That of 707

New York—It may pay to move passengers through the atmosphere at Mach 6 to Mach 20.

Working from what he believes to be attainable assumptions, Robert A. Cornog of Space Technology Laboratories, Inc., estimates direct costs of hypersonic flight will run 5 cents/ton-mile or, with a load factor of 0.5 and 200 lb./passenger, 1 cent/seat-mile.

These rates, Cornog pointed out to the American Rocket Society, are less than half the estimated operating costs of the Boeing 707 or Douglas DC-8, substantially lower than those achieved by current turboprop aircraft (for a contemporary model estimated at $1.07/ton-mile), and at least competitive with those of most airplanes projected. If they can be obtained, he added, long range air traffic may increase significantly in a decade.

It probably will be at least 10 years before the first hypersonic transport prototype is built. Even then, the high takeoff acceleration (estimated for the first boost-glide vehicles to be 3-4Gs for a duration of 5-8 min. would make it necessary for passengers to undergo rigid physicals to weed out people suffering from such things as cardiac trouble and to wear special harnesses during takeoff.

Despite such drawbacks, Cornog believes hypersonic flight will prove a financial success. It will cost the passenger less than half the price of a seat on the first U.S. turboject transports and, he says, it has been estimated that, on many routes, any time the price is cut in half, traffic density can be expected to increase by a factor of 10.

Cornog's conclusions are based on a study of the influence of various design parameters on the flight economics of hypersonic aircaft. He valuates in detail the hypersonic airplane, which will cruise at constant speed, and the boost-glide vehicle.

The boost-glide craft does not now appear too promising, but Cornog believes the Air Force's Dyna-Soar program could turn up information that could change the outlook for boost-glide transports. The big drawback now is aerodynamic heating. (When this problem is solved, the boost-glide aircraft might be more economical to operate than a hypersonic cruise vehicle.)

At present, to cover a course of only 3,500 naut. mi., a glide vehicle with a lift/drag ratio of 5 must have an initial flight speed of 16,000 fps. Concessions in design required to cope with aerodynamic heating at these speeds could, Cornog believes, seriously compromise structural weight and aerodynamic performance of long range boost-glide vehicles.

On the other hand, a hypersonic airplane that would cruise at a constant speed of 8,000 fps. would encounter stagnation temperatures in air less than one third those at 16,000 fps. and, hence, could use lightweight refractory metals that would melt or soften at the higher speed. Such vehicles, using either rocket or airbreathing engines, would be both feasible and economical, he maintains.

In his discussion of the economics of a hypersonic cruise vehicle, Cornog omits overhead costs and considers only direct flying costs. Although overhead constitutes roughly 45% of total operating costs, he says, it is comparatively insensitive to operational characteristics of the flight equipment; i.e., it is difficult to reduce overhead costs of an airline by changes in airplane design.

But direct flying costs, which constitute about 55% of total operating costs, are very much affected by operational characteristics of the aircraft. As a result, they are of special interest to the designer, the manufacturer and to the operator of commercial aircraft.

Cornog divides direct flying costs into fuel costs and structural costs. Structural costs include interest on invested capital, depreciation and obsolescence, overhaul, repairs and maintenance, and insurance and taxes on equipment.

He makes a constant allowance of 0.5 cents/ton-mile for salaries of flying personnel, which he believes will be small compared to other expenses and also relatively insensitive to changes in design parameters. Cornog also makes an allowance of several hundred miles for the length of the glide path a hypersonic airplane will need for deceleration prior to landing but does not consider distance (estimated at less than 100 mi.) required to boost the hypersonic aircraft to cruise speed.

The six vehicle parameters which most affect the direct flying costs styling are:

• **Unit cost** of propellants and fuel.

• **Specific impulse** or specific fuel consumption.

• **Aerodynamic properties** of the vehicle, especially the lift/drag ratio.

• **Unit cost,** including repairs and maintenance, of the vehicle's dead weight structural elements.

• **Depreciation factor;** i.e., the number of flights the vehicle can make before it is worn out or becomes obsolete.

• **Amount of payload** that can be de-

livered per unit mass of vehicle structure.

The first parameter, Cornog points out, affects only fuel cost; the next two, both fuel and structure costs; and the last three, just structure cost.

To compute direct flying costs for different hypersonic vehicle configurations, Cornog assigned representative numerical values to the six cost determining parameters, beginning with a consideration of the cruise phase.

For unit costs of propellants and fuel, he chose a reference rocket propellant combination of petroleum-based fuel and liquid oxygen which at 1¢/lb. in large-scale use would be much cheaper than any other chemical propellant with comparable specific impulse. Liquid hydrogen, for example, is expected to cost at least 10¢/lb. Gasoline or kerosene at 2¢/lb. is used as the reference for turbojet and ramjet fuels.

Three types of powerplants are considered in regard to specific impulse and specific fuel consumption: chemical rockets, air-breathing engines and nuclear systems. The reference specific impulse for the chemical rocket is set at 310 lb.-sec./lb.

Taking 6,000 fps. as the top cruise speed for ramjets having subsonic combustion chambers, Cornog estimates the thermal efficiency for a ramjet at this speed at more than 0.50. If a fuel such as gasoline with a heat of combustion of 19,000 Btu/lb. were used in the ramjet, the specific impulse would be 1,240 lb.-sec./lb. or four times that of the reference rocket propellant. And the fuel costs per lb.-sec. of impulse of a ramjet flying at 6,000 fps. would be about half those of the rocket.

At the lower flight speeds of the booster phase, a turbojet with a specific fuel consumption of 1.0 lb./hr./lb. of sea level static thrust would have an equivalent specific impulse of 3,600 lb.-sec./lb. Thus, Cornog conceives of the development of combination turbojet-ramjet booster units which will have high thrust-to-weight ratios and specific impulses several times those of straight chemical rockets.

If liquid hydrogen with a heat of combustion of more than 50,000 Btu/lb. were used instead of gasoline in the airbreathing engines, specific impulse would be further increased by a factor of more than 2½. At present, however, the higher cost of the liquid hydrogen would offset the gain.

Going to a solid-core nuclear reactor using hydrogen as the working fluid, Cornog believes it will be possible to obtain specific impulses of 1,200 lb.-sec./lb.

Used in a ramjet or turbojet with air as the working medium, the solid core reactor will have vastly greater equivalent specific impulse and fuel cost will be trivial. But here, fuel consumption becomes a minor matter compared with the weight of the heavy components and shielding required in a nuclear-powered transport.

A lift-drag ratio of six is set by Cornog for hypersonic aircraft cruising at 6,000, 8,000 or 10,000 fps.

The fly-away cost of a contemporary jet airplane, which has an empty no-load weight of 100,000 lb., is approximately $5 million. This amounts to an initial cost of $50/lb. Based on a projected life of 10,000 hr., the depreciation and obsolescence costs work out to $0.005/lb./hr. Maintenance, repairs, interest payments, taxes and insurance may amount to $100/lb. The total cost then for the flying structure of a contemporary jet aircraft is approximately $0.015/lb./hr.—$50/lb. plus $100/lb. divided by 10,000 hr.

Unit structural costs of future hypersonic aircraft will be more, perhaps $0.10/lb./hr. It may cost $100/lb. to fabricate a hypersonic vehicle (including boosters) which is likely to have a service life of only 2,000 flight hours as a result of the greater stress on the structural elements. Another $100/lb. may be required for maintenance, repairs, etc.

This amounts to $200/lb. over a 2,000 hr. life.

The structural factors—ratio of empty, unloaded weight of a stage to its initial gross weight—for the hypersonic aircraft used in the report are 0.1 and 0.2 for payload stages and 0.05 and 0.1 for boosters. For contemporary transports, the factor is about 0.5.

In figuring booster costs, Cornog assumes each booster will be recovered and re-used and that the flight time of each launch cycle will be an hour. Based on the reference value of 10¢/lb./hr., unit structure cost of the booster will be 10¢/lb. each time the booster is used.

Turbojet lifting units with sea level thrust/weight ratios as high as 100/1 have been proposed. Cornog believes development of practical air-breathing boosters with thrust/weight ratios of more than 20-to-1 and capable of reliably operating over a wide range of Mach numbers will prove as difficult as development of recoverable rockets having a structural factor of 0.0175. Attainment of either objective would help reduce booster costs, which on a cents/ton-mile basis are much larger than the other direct flying costs.

Assuming that each hypersonic aircraft will make six round trips per day for a flight duty time of about 10 hr./day and will have 33 seats available for each flight, Cornog estimates 20 vehicles will suffice for transcontinental traffic and 10 for intercontinental.

Economic advantages of hypersonic flight, Cornog says, appear to favor the large operator. While every company will need at least one airplane in order to operate, several vehicles are desirable to allow for time-consuming maintenance. Moreover, the larger company will have greater traffic flexibility.

If, as it now appears, a dozen or so hypersonic aircraft can handle all traffic on a given route, there will be room only for a few companies to profit.

Hypersonic Specs

Possible specifications for a representative hypersonic aircraft as outlined by Robert A. Cornog:

Range	3,000 naut. mi.
Cruise powerplant (chemical energy)	airbreather
Specific impulse (lb.-sec./lb.)	1,240
Flight speed (fps.)	6,000
Lift/drag	6
Structural factor	0.1
Structure cost at 10¢/lb./hr.	1.0
Fuel at 2¢/lb. or propellant at 1¢/lb.	0.5
Booster (3¢/lb. at 6,000 fps.) (7.5¢/lb. at 10,000 fps.)	3.0
Labor (0.5¢/ton-mile)	0.5
Total direct flying cost (cents/ton-mile)	5.0

Carmichael Promoted In Fairchild Shift

Hagerstown, Md.—James H. Carmichael has been named executive vice president of Fairchild Engine & Airplane Corp. in the latest of a series of reorganizational changes, moving up from vice president of the Commercial Transport Division.

Carmichael, former president and board chairman of Capital Airlines, will also continue to head the Commercial Transport Division, according to Fairchild President Richard S. Boutelle. Carmichael joined the company early in September.

The board of directors last week also elected F. S. Bennett, Jr., comptroller, as vice president and comptroller and expanded the responsibilities of F. E. Newbold, Jr., vice president-coordination of planning, to include marketing and engineering.

In another move, William G. Key will return as public relations director after a year's absence from the company during which he served as administrative assistant to Vice President Richard M. Nixon.

During Key's absence, the company's public relations program has been directed by Lou Davis, assistant to the president. Although plans are not yet final, Davis probably will be in charge of the company's promotional program for its F-27 turboprop transport.

Tight Fiscal 1960 Budget Plans May Force IRBM Cutbacks

Washington—Final decisions on the fate of the Thor and Jupiter intermediate range ballistic missile programs and on the National Aeronautics and Space Administration's bid to take over the space activities of the Army Ballistic Missile Agency probably will be made during the next two weeks.

Time schedules for the decision, plus indications that tight Fiscal 1960 budget policies will force cutbacks in several missile programs, were made by Defense Secretary Neil H. McElroy.

At his first press conference since returning from a five-week tour of Far Eastern defense installations, McElroy said that either the Thor or Jupiter programs, or possibly both, will be halted after the limited number of missiles now on order have been completed. He said: "We might not have the requirements for the numbers of either one of these, or of both of them combined, that we have been thinking about up to this point."

A spokesman in McElroy's office said last week that the Defense Department had "been thinking of a heavy deployment of IRBMs" but that now "we have been able to reduce our estimates."

Both McElroy and his spokesman attributed the re-evaluation to the fact that, in Fiscal 1960, more emphasis will be placed upon the intercontinental ballistic missile. McElroy said:

"The further you go down the road toward an operational capability of the ICBM, the less interesting it is for us to deploy additional . . . IRBMs, and we are coming closer to the time of operational capability of the Atlas."

The Defense Department spokesman later agreed that, in referring to an operational ICBM, McElroy was "talking quite a number of years ahead."

Two primary factors behind the decision to cut procurement of intermediate range ballistic missiles are the Administration's decision to try and hold the line on defense spending and the fact that only two North Atlantic Treaty Organization countries have agreed to accept the 1,500-mi. missiles. Four Thor squadrons are scheduled for Great Britain, two Jupiter squadrons for Italy.

The U. S. commitments to England and Italy will be carried out, McElroy said, "regardless of what the decision is as between Thor and Jupiter because these have already been ordered and are being produced."

In discussing the 1960 budget, which is under preparation, McElroy said the three services have been told to try and hold their requests within the funds limits of their Fiscal 1959 budget, although he added that "this was not to be regarded as a rigid ceiling."

He declined, however, to repeat an earlier prediction that next year's budget will be slightly higher than that for Fiscal 1959 and said the Defense Department hopes "to lop off some marginal programs or reduce them." He added:

"If we can, then I would also hope that we could take more promising programs and accelerate them. Now just how that's going to come out in total I can't say. But I don't believe that the President wants us to do other than to try our best to make a better use for our defense appropriations, and if that can mean a reduction it will mean a reduction, if it means an increase as far as this department is concerned, it will mean an increase.

"And again, the President will then have his own decision as to what he wants to support in his proposal to Congress."

Later, he added, "I'm sure that he (the President) will want to come into budgeting this year in some detail . . ."

Majority of the "marginal programs," McElroy said, lie within the missile field. "We think," he added, "that there has been a proliferation of missiles beyond what is wise . . ."

Other than the intermediate range ballistic missile, McElroy failed to specify any other missile programs that face cutbacks, although other weapons, particularly in the air-to-air field, may be killed in an effort to hold the Fiscal 1960 budget in line.

The Defense Secretary also said he hopes the requirements for interceptor aircraft can be reduced in 1960 by the deployment of anti-aircraft missiles and spiked hopes for improving the Air Force's airlift capability during the year. On interceptor aircraft, he said:

"Now, I don't see the anti-aircraft missile for some time replacing the manned aircraft interceptor, but I think that it is realistic to expect that there would be a reduced requirement for interceptors as we get our anti-aircraft missiles in place."

So far as additional airlift is concerned, McElroy said the Joint Chiefs of Staff, "after repeated review," have determined that additional airlift has "relatively low priority."

AIA Election

Phoenix—Aircraft Industries Assn. board of governors elected the following executives as officers of the association for 1959 at its annual meeting last week:

- Chairman—C. J. McCarthy, board chairman of Chance Vought Aircraft Inc., succeeding George M. Bunker, chairman of the Martin Co.
- Vice Chairman—D. C. Ramsey.
- President—Orval R. Cook.
- Vice President—J. S. McDonnell Jr., president of McDonnell Aircraft Corp.
- Vice President—L. D. Webb.
- Secretary-treasurer—Harrison Brand, Jr.

Elected to the association's executive committee were William M. Allen, Boeing Airplane Co. president; L. A. Swirbul, Grumman Aircraft Engineering Corp. president; Cook, Ramsey, McCarthy and McDonnell.

Possible Defense Cuts Warned by AIA Head

Washington—Aircraft industry was warned last week to expect continued controls on total defense expenditures, continuance of Defense Department policy of spending by fiscal quarters and possible cutbacks in programs to keep within prescribed limits.

Orval R. Cook, president of the Aircraft Industries Assn., warned in his annual report that the outlook for the coming year may not be much different than the tight-money situation that arose in the latter part of 1957. At that time, cutbacks, stretchouts and cancellations of programs were ordered by the Eisenhower Administration in an effort to reduce defense spending and keep within the prescribed national debt limit.

Cook, speaking at the AIA board of governors meeting in Phoenix, said any thought that defense expenditures will be increased to any large degree in Fiscal 1960 already has been dispelled by the military services.

The aircraft industry, he said, will do everything possible to cooperate with the services in keeping costs down and expenditures within planned limits. He added, however, that the complexity of developing and producing modern weapons, plus the need for new scientific break-throughs, are not always conducive to a strict month-by-month expenditure apportionment.

As a result of changing demands in military requirements and cutbacks and cancellations of contracts, industry employment has declined from 982,000 in early 1957 to 743,000 but is expected to level out at about 750,000 for the next several months, Cook said.

Cook also said the Defense Department policy in which progress payments were reduced, requiring a greater investment by individual companies, has forced a number of major prime contractors to make extremely large loans from private capital.

Sentry Satellite Shot Planned for Dec. 15

Washington—First U. S. reconnaissance satellite, Air Force's WS-117L Sentry, will be boosted into orbit from Vandenberg AFB, Calif., on Dec. 15, according to the present schedule. A follow-up Sentry shot may be tried about two weeks later.

While this initial Sentry firing will be the first U. S. attempt to scan the globe with a camera eye, the Russians already may have put a reconnaissance satellite into high orbit.

On Sept. 24, a 40.007-mc. signal, one of two frequencies used by the Soviets, was picked up at the Air Force Missile Test Center, Cape Canaveral, Fla., and heard for at least three hours (AW Oct. 27, p. 23). No U. S. aerial vehicle has been using this particular frequency.

To be heard for this length of time, the signal could have been beeped from a satellite orbiting in the same direction of the earth's rotation, and at approximately the same speed, at an altitude of about 22,000 mi., affording an opportunity to view the globe with refined equipment. Another possibility is that the signal may have been issued from a Soviet lunar probe, with the missile facing the U. S. for a considerable time.

Sentry Timetable

Timetable for the Sentry, a Lockheed Missile Systems Division project under cognizance of the Air Force Ballistic Missile Division, has fluctuated as a result of lack of adequate financial support and because of the difficulties encountered. First shot was not expected to materialize before next spring, but funds for the development of tracking have been provided to accelerate the project. Also, work on facilities at Vandenberg has been speeded considerably.

Highlights of the first Sentry firing include:

- **Shot will be made from** one of two Thor intermediate range ballistic missile pads now practically completed at Vandenberg. Meanwhile, work on the WS-117L pad, which will accommodate an Atlas intercontinental ballistic missile as the booster, is being pushed to completion for ultimate Sentry firings.
- **Douglas Thor** intermediate range ballistic missile as a booster, coupled with a Navy Polaris IRBM second-stage solid propellant rocket, will be used to push the payload into relatively low orbit. Lockheed also is weapon system manager on the Polaris project. Trouble has been experienced with static tests of this Polaris second-stage solid rocket at Santa Cruz, Calif., where the test stand was damaged by blast.
- **Payload, weighing between** 400-450 lb. for this first Sentry shot, will consist of an ejection-type telescopic camera and associated telemetry equipment, with provision for orienting the satellite so that it can constantly view the earth. This payload, a rough version of original projections, will be the first in a series of several arrangements expected to return successively increasing amounts of information.

Scanning Systems

The later, more-sophisticated versions of the Sentry will use other scanning systems, including infrared and television-type cameras. One scheme envisions such a scanner housed in a clamshell-type cone-capsule (AW June 23, p. 18), but apparently this configuration was not available for the December firing.

Success of this first firing and early follow-up shots probably will have a pronounced effect upon the amount of financial support that will be funneled into the Sentry project. Lockheed, as well as Air Force planners, hopes to refine the Sentry system over a long period of painstaking development to bring out some highly effective reconnaissance satellites.

- **Orbit aimed for will be** 190-mi. circular north-south path, providing an opportunity to view the entire surface of the globe as it rotates beneath the satellite.
- **Time in orbit probably** will be very brief, perhaps not more than eight to 10 passes around the earth, after which the satellite will re-enter the earth's atmosphere and burn up, since no recovery features are incorporated in this first Sentry payload.
- **Telemetered signal will be** on an intermittent basis, so that preselected terrain may be viewed and details relayed to ground stations.
- **Tracking will involve stations** in Alaska and Hawaii, as well as a ship station positioned about 950 naut. mi. down range.
- **All equipment, with exception** of Thor and Polaris second stage, is being assembled at Lockheed Missile System Division's Palo Alto facility and will be shipped from there to the Vandenberg site in time to meet the December firing date.
- **Missile Systems Division** Weapons Systems Manager, J. H. (Jack) Carter, is Lockheed's key coordinator of the project, having spearheaded the work on the Sentry system since its inception.
- **While the Sentry** is the over-all designation for the WS-117L project, the Air Force probably will designate each shot with an individual operational name.

Astrodyne Plans Solid Propellant Push

Astrodyne, Inc., a major producer of extruded, solid propellant jet-assisted takeoff units, is preparing to develop a cast propellant production capability that it believes will be equivalent to any in this field, which is now dominated by Aerojet-General Corp. and Thiokol Chemical Corp.

As a result of the growing surplus of JATO units and the rapidly decreasing JATO applications, Astrodyne does not expect to produce the extruded units after the first of next year. The company has already started to convert twelve 100-gal. mixers formerly used in the production of extruded propellants, where the thickness of the polymer necessitated high powered mixing blades, to the lower power requirements of the more liquid, cast material.

In addition to these, Astrodyne already has two 50-gal. cast propellant mixers in operation and one 250-gal. unit on order.

Mixing capacity is the key to solid propellant production capability, according to John Tormey, Astrodyne's director of engineering and development. The equipment needed to actually cast the solid grains is comparatively inexpensive and the drying units are suitable for production of either type of solid propellant.

Although Astrodyne has extruded single grains up to 16-in. in diameter, this is considered to be about the limit for extruded propellant grains. Cast propellants definitely appear to have the edge where grains of greater size are called for.

Also, 280 lb.-sec./lb. may well prove to be the limiting specific impulse for conventional solid propellants of either type. When solids reach specific impulses above this point, they are not likely to resemble the rubbery materials in use today. And the development of the new high energy solid propellants is expected to require major technological advances that may have to start almost from the beginning with basic research in the physical sciences.

President Backs Air Force in GAO Battle

By Katherine Johnsen

Washington—Air Force's tug-of-war with the General Accounting Office over release of its report entitled "Survey of Management of the Ballistic Missiles Program" (AW Nov. 17, p. 34) reached a stalemate last week.

President Eisenhower backed Air Force Secretary James H. Douglas in his refusal to release the entire report outside the Air Force. "In my judgment," the President wrote Rep. Clare Hoffman (R.-Mich.) "the public interest is not necessarily served by divulging the advice, suggestions or recommendations which subordinate employes periodically make to their superiors."

Rep. John Moss (D.-Calif.), chairman of the House Government Information Subcommittee, will continue to push for the report's release. He will seek the cooperation of Rep. Carl Vinson (D.-Ga.), chairman of the Armed Services Committee; Rep. George Mahon (D.-Tex.), chairman of the Appropriations Subcommittee on the Armed Services, and other congressional leaders. Moss threatened to offer an amendment to USAF's budget for next year requiring release of the report to the General Accounting Office.

USAF, after considerable prodding, did turn over to GAO a 35-page "statement of facts" drawn from the report. GAO says it wants the full report, not only to assist it in its own comprehensive investigation of "all administrative aspects" of the ballistic missile program but also to evaluate Air Force's system of self-policing by the Inspector General's organization.

The report is viewed as a "showdown" case. It is the first of a series of USAF Inspector General reports wanted by the General Accounting Office. Other investigations on the agenda of the Inspector General for the July-December period of this year which interest GAO include:

- **Advertising versus negotiation** in procurement.
- **Quantitative and qualitative** changes in procurement programs.
- **Contract cost overruns.**
- **Maintenance and modification** programs.
- **Electronic data processing** systems.

Comptroller General Joseph Campbell reported that GAO is accelerating its investigative activities "on such vital matters as modern weapon systems and the determination of requirements, with special attention to important end items such as jet engines and missiles.

"Our primary objective," he told the Moss subcommittee, "is to determine how effective these programs are in supporting the accomplishment of the military missions involved, as well as how efficiently and economically they are carried out." Several investigations of Air Force research and development projects already are under way.

The Air Force made the investigation of its ballistic missile program from Jan. 14 to Feb. 21 on the recommendation of Lt. Gen. S. E. Anderson, commander of the Air Research and Development Command. Here are the key findings from the summary submitted by USAF to General Accounting Office:

- **"The concept of management** adopted for the ballistic missile program had proven sound. In the development and test areas, important advantages were gained because the Ballistic Missile Division complex exercised total management responsibility for all weapon systems of the ballistic missile program. There was strong evidence that this concept of management and the professional-political status possessed by the military-technical management group must be continued to assure success in achieving Air Force mission objectives."
- **"The Air Force was committed** to a continuance of its dependency upon the Ramo-Wooldridge Corp. for technical know-how in the management of the ballistic missile program in the absence of an Air Force in-house capability. The future role of the R-W Corp. involved uncertainty because of its expressed desire to participate in the competition for ballistic missile hardware contracts."
- **"Full benefit of normal Air** Staff action in the ballistic missile program had

Technicians Ready Jupiter Nose Cone

Operational nose cone for Jupiter intermediate range ballistic missile is prepared for launching at Cape Canaveral, Fla. Developed by Army's Ballistic Missile Agency and produced by Chrysler for Air Force use, Jupiter is first stage of Army's moon rocket.

not been obtained. This deficiency was attributed to time limitations imposed upon the review process. However, in large measure this deficiency could be more properly attributed to failure of Air Staff agencies to perform effective liaison with the BMD complex.

• **"At no time had there been** a blank check extended to the Air Force to support an unlimited ballistic missile program. The policy of incrementally funding the ballistic missile program had proven sound.

• **"The purchasing practices of** contractors were not consistent with acceptable Air Force standards. As a result, delays and excessive costs were being incurred. Air Force control was difficult because of contractor disregard for approved Air Force procedures, lack of capability and time and pressures of the program.

• **"The practice of contracting** with the R-W Corp. for many administrative support services without exploring the cost of alternative sources had not been justified.

• **"Control of R-W was held,** through a 10-year voting trust agreement, by S. Ramo, D. E. Wooldridge and H. L. George, notwithstanding the interest of Thompson Products, Inc., as principal stockholder and creditor. Thus, the Air Force would continue to deal at least until 1964 with the individuals who were the basis for the original source selection." Ramo-Wooldridge and Thompson Products were recently merged (AW Aug. 25 p. 24).

North American Sales Drop in Fiscal Year

New York—North American Aviation Corp. reported a drop in sales for its fiscal year ended Sept. 30 to $904,038,848 compared with $1,243,767,483 the year before. It still was the third highest sales volume in North American's history.

Net income declined from $33,864,462 or $4.22 a share last year to $26,786,294 or $3.34 a share. Because of initiation of new government orders, such as the B-70 chemical bomber, and acceleration of others, North American's sales were 30% higher than the company forecast.

Other company reports:

• **Grumman Aircraft Engineering Corp.** reported a steep decline in nine-month earnings mainly because of write-offs on the Gulfstream executive transport. These amounted to $7,900,000 compared with $2,150,000 last year. Nine-month sales exceeded those of last year —$161,188,545 compared with $147,514,031. But earnings fell from $4,883,705 last year to $1,356,107 this year.

• **Fairchild Engine & Airplane Corp.** reported a nine-month loss of $4,390,000 because of F-27 write-off costs. Tax credits gained by a change in tax laws cut the loss figure from $5,003,000 reported at mid-year. These credits, amounting to $4,821,000 offset an operating loss of $9,211,000. Total sales for the period were $107,401,000.

Three British Lines Planning to Merge

London—Three British independent airlines, Airwork, Transair and Air Charter, plan to integrate completely next year with formation of a new company.

Airwork, backed by the Furness-Withy and Blue Star shipping companies, owns Transair and holds a major interest in Air Charter. Group owns 43 aircraft including one Bristol Britannia and five Vickers Viscounts—making it the largest independent airline organization in Britain.

When fully integrated, Airwork says, the airlines will cease operating from Blackbushe Airport and concentrate on Gatwick and Southend.

News Digest

Lycoming Division of Avco Manufacturing Corp. has received a $2,254,000 order for more than 1,000 piston engines, from Piper Aircraft Corp. Engines are the 160 hp. Lycoming O320-B for the twin-engine Piper Apache, and the 250 hp. O540 which powers the single-engine Comanche.

Hughes Aircraft Co., El Segundo, Calif., has received a $16,238,469 contract from Air Force for production of aircraft and weapons control systems for the Convair F-106 all-weather jet interceptor. In another Air Force action North American Aviation has received a $9,099,998 contract from Air Materiel Command for research in supersonic environment for Phase I development of the B-70 aircraft.

First flight of Kaman Aircraft Corp.'s new H-43B crash-rescue helicopter, powered by a Lycoming T53 gas turbine engine, was made at Bloomfield, Conn., last week when the company started ground resonance tests.

Air Force Atlas intercontinental ballistic missile traveled 3,100-mi. in a trouble-free flight last week after the 14th firing of the intercontinental ballistic missile from Air Force Missile Test Center, Cape Canaveral, Fla. The firing, a prelude to an attempt at full-range 6,000-mi. launch, marked the longest flight made since Atlas tests began from Canaveral in June, 1957.

North American Aviation last week received a $18.9 million production contract from Air Materiel Command for its Hound Dog (GAM-77) air-to-surface missile for the Boeing B-52G intercontinental bomber. Contract was the first production order in the Hound Dog Project.

Bids are due this week for Air Force's new airborne early warning (AEW) aircraft competition, with proposals expected from Boeing, Convair, Douglas, Lockheed and possibly others (AW Nov. 17, p. 23, Oct. 20, p. 23). General Electric, which is avionic sub-systems manager for Douglas, also reportedly is working with Boeing on airborne radar, infrared systems for its proposal. New AEW program will have extremely heavy avionics content.

Launching Vanguard satellite originally scheduled for early December has been postponed until after the first of the year by the National Aeronautics and Space Administration. Reason for delaying the firing until after the end of the International Geophysical Year is to modify the Vanguard vehicle in accordance with the findings of a reliability study now in progress.

Sud Triple-Turbine Helicopter

Paris—Sud Aviation is developing a triple-turbine helicopter designed to carry at least 20 persons under all-weather conditions. Powerplants are three Turbomeca Turmo 2 turbines producing 396 eshp. each. First flight is scheduled for the end of January.

Sud engineers here declined to discuss the triple-turbine helicopter configuration except to say that it is of intermediate size. The triple turbines are connected to a single rotor and the aircraft reportedly will reach optimum cruise speed with only two turbines functioning. Dual controls are installed and provision is being made for automatic pilot devices.

This helicopter development may tie in with negotiations between Sud Aviation and Republic Aviation Corp. toward closer collaboration on products manufactured by the companies. Republic now manufactures and markets the Sud Alouette five-place turbine helicopter and has been showing the Sud two-place Djinn helicopter to U. S. military and commercial representatives.

Eastern Faces 'Third-Crewman' Strike

Flight engineers' union threatens walkout if Eastern requires engineers to be pilot-qualified for jets.

By Glenn Garrison

New York—Eastern Airlines last week faced the possibility of the industry's first strike over the controversial third-crewman issue which has cast a lengthening shadow over hopes for the U. S. jet age.

The airline has reached "a new accord" with its pilots concerning turbine plane operations, and Eastern pilots are now undergoing flight training in the airline's newly delivered Lockheed Electra turboprops. Flight Engineers International Assn. responded with warning of an imminent strike if the agreement is maintained.

Eastern's position in the third-man question is that its engineers will be required to take pilot training to serve on its turbojet aircraft, but crews on the Electras will maintain their status quo, that is, flight engineers will not be required to be pilot-qualified. This position is in accord with Presidential Emergency Board recommendations announced last August after hearings on stalled negotiations between Eastern and its engineers and pilots.

A new contract between Eastern and its Air Line Pilots Assn. members was signed Aug. 22, covering all terms of employment except that the pilots reserved the third man issue for further negotiation. Agreement between Eastern and the pilots on this issue was reached Nov. 13. It is not, however, a part of the basic contract but a separate agreement.

National Airlines' pilots and engineers, meanwhile, last week went ahead with ground and flight training in Pan American World Airways 707-121s which National plans to operate between New York and Miami next month under a lease arrangement.

National signed contracts last January with both its pilots and engineers, good until January, 1960. In the event of the introduction of turbine aircraft on National's routes during the contract term, however, it was stipulated that the contracts could be reopened to discuss working conditions connected with the jets and turboprops. At that time jet aircraft weren't expected in National operation until 1960, but the PanAm lease deal changed the picture.

The pilot's contract with National has been reopened under this clause, and discussions are being held. Third man issue is not being pressed at this point, apparently because nobody wants to disturb negotiations while things are going smoothly. The engineers have not reopened their contract and may not raise the qualification issue unless their hand is forced.

National understandably doesn't want to discuss the situation at all. ALPA, however, feels it has definite assurance that the airline's management has agreed verbally with the pilot position. Most of the airline's flight engineers are pilot-qualified.

Industry Pattern?

Another possible reason why National's pilots prefer not to commit themselves irrevocably at this time is the chance that Eastern's case may set an industry pattern.

Pan American continues to operate its transatlantic jet service with 19 supervisory pilots drawn from its entire system. Airline believes it can go ahead on this basis for some time if need be, and has even announced increased New York-London flights of six times a week beginning Nov. 27. Daily schedules continue to Paris and Rome.

By drawing on its supervisors to this extent, however, the airline is weakening its crew training program and when and if the issue is finally settled, may have to cut schedules temporarily to catch up. The pilots, flying up to the legal 85 hr. a month, won't find time for training other pilots.

American Airlines and ALPA have scheduled a meeting Nov. 26 to try and advance their bogged-down contract negotiations. Meeting was initiated by the airline, through Railway Labor Act procedures. American has signed a contract with the flight engineers. A block to collective bargaining between the parties in its case with the pilots, which has also been before an emergency board, has been the question of whether piston and jet agreements are to be made separately, as the union wants, or in one package, as the airline wants.

American announced last week that its Electras would go into scheduled service Jan. 23, with its Boeing 707-120 inaugural two days later on Jan. 25. These plans are a revision of earlier announcements of jet service starting Jan. 11 with Electra service following by a few weeks.

Initial Electra services will be between New York and Chicago on a six daily round trips basis, eastbound scheduled time 2 hr., 5 min. Turboprop flights will be inaugurated between New York and Detroit in February, and to other cities within the next few months.

The 707-120s will be scheduled daily between New York and Los Angeles, scheduled times 4½ hr. eastbound, 5¼ hr. westbound. By mid-1959, the airline hopes to be serving San Francisco, Chicago, Washington, Baltimore, Dallas and Boston with its turbojets.

Eastern, in a letter sent Nov. 14 to all its flight engineers, advised them that there had been "considerable misunderstanding" as to the intent and possible results of its flight engineer jet training program. Nothing could be further from the truth, the engineers were advised, than reports that the company was giving the flight engineer's job to the pilots.

Under the program, engineers who want turbojet assignments will be required to take pilot training on their own time, but at Eastern's expense. Answering the question "Does this decision of the company amount to adoption of the ALPA program?" Eastern assured its engineers, "Definitely not." Original ALPA proposal, the airline pointed out, called for pilot-engineers on turboprop as well as turbojet equipment. All through emergency board hearings, Eastern said, it resisted this position and the Board rejected it.

The program will not allow ALPA to take over jurisdiction of the flight engineers, Eastern promised, because the company will continue to deal with the certified bargaining representative of the engineers, as required by law. No change will occur, the airline said, unless engineers vote for it.

Arbiters File Award On Western Dispute

Los Angeles—An arbitration award which calls for a hike in pilot pay and a three-year contract, has been filed in U. S. District Court here, ending a year-long dispute between Western Air Lines and the Air Line Pilots Assn.

Award was submitted to the court by William E. Simkin, arbitration board chairman, although a dissenting opinion was filed by the Western-appointed member, who objected to future wage raise provisions.

Basic conditions of the award are:

• **Duration.** A three-year contract, retroactive to Oct. 1, 1957, and extending

to and including Oct. 1, 1960.

• **Wages.** Pilot wage rates were fixed for the period Oct. 21, 1957, to March 1, 1959. Under the award Douglas DC-6B captains with nine years service or more will receive $1,597 a month for a maximum of 85 hours work. On March 1, the rate will be increased to $1,671 a month. The previous wage level was $1,489.

• **Mexican flights.** The arbitration board, granted the pilots premium pay of $1.00 an hour for captains and approximately $.50 an hour for first officers for flying the 1,555-mi. route.

• **Duty time.** Pilots were guaranteed one hour of flight pay for each two and one-half hours of duty time beginning next June 1, and were simultaneously granted one hour of flight pay for each four hours of duty time effective Jan. 1, 1960.

Smathers Asks Probe Of Jet Investments

Washington—Sen. George Smathers (D.-Fla.) said last week that the airline industry, in investing $5 billion in new jet aircraft, may be "catapulted into financial distress to a point where the government will ultimately be called upon to pick up the tab."

Smathers declared that the airlines "may be pursuing a policy of 'keeping up with the Joneses' in their extensive purchase of jet equipment when its present equipment appears to be adequately servicing the public needs." He called for a congressional investigation to determine whether the airlines' jet investment "is sound—or whether it constitutes a reckless plunge into financial indebtedness. . . ."

Air Transport Assn. said it would "welcome" the investigation. Pointing out that Soviet civil jet aircraft "have been in regular service for some time," ATA declared that "the airlines believe that their privately financed jet equipment program is very much in the national interest" and called for the removal of "many government-imposed obstacles."

Smathers said that the investigation should include "a thorough review of the economic and financial policies of the industry, existing regulatory policies of the Civil Aeronautics Board and other governmental agencies, the adequacy of the industry's existing equipment to service the public, the disposition of its present equipment, the proper role of the feeder lines in relation to the trunk lines, the function of cargo carriers and freight forwarders and the adequacy and needs of existing airport and airport facilities to cope with the problems brought on by the substitution of jet planes for conventional piston engine carriers."

Capital, IAM Reach Agreement

Washington—Capital Airlines' president David H. Baker and top union leaders reached an agreement late last week that was expected to settle a five-week mechanics strike and bring about a full resumption of the airline's service by Wednesday.

The carrier planned to restore its service immediately after ratification of the agreement by members of the local chapter of the International Assn. of Machinists. An affirmative vote, as expected, would give the mechanics a 41 cent increase in wages over a three year period, the amount agreed to earlier in the week by Northwest Airlines and its chapter of International Assn. of Machinists.

The Capital strike also led to a mutual aid pact signed by six major airlines and designed to provide some financial protection to carriers grounded by an active strike (AW Nov. 10, p. 40). Last week, the Supplemental Air Carriers Conference asked the Civil Aeronautics Board to rule against the pact on grounds that the agreement creates "one giant airline cartel" adverse to the public interest.

Under the pact, signed Oct. 20 by American, Capital, Eastern, Pan American, Trans World Airlines and United, an estimated $100,000 was donated to Capital. At least three unions violently criticized the pact and threatened an industry-wide strike if CAB approved.

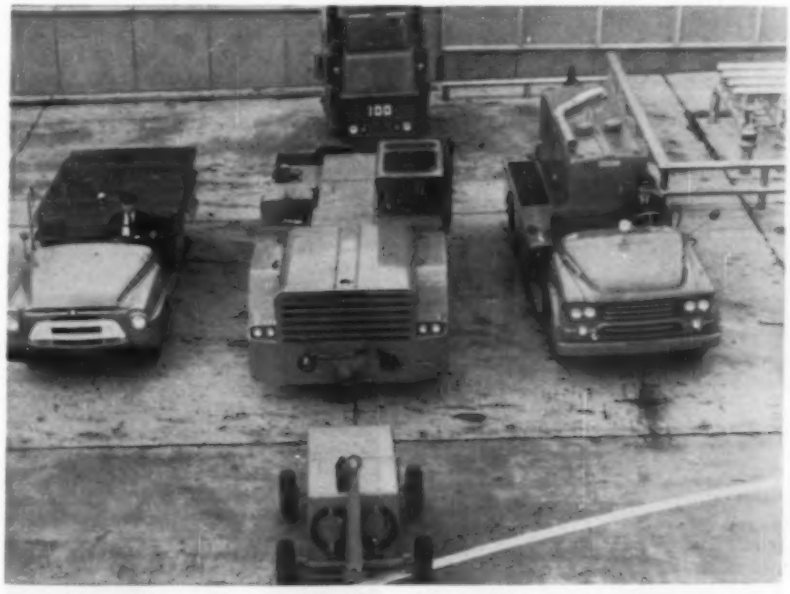
Under the terms of the agreement reached by Baker with the union heads, Capital won a three-year contract and the right to operate its maintenance and overhaul shops on a seven-day-a-week basis rather than the five-day week called for in previous contracts.

Grievance procedures were established to follow a fixed pattern and shop foreman will be permitted to retain their seniority which the local union head had threatened to deny them because they remained on the job during the strike.

The Capital mechanics won a 41 cent increase in wages over a three-year period. Of the 41 cents, 15 cents will be retroactive to October, 1957. An additional 18 cents is effective as of October, 1958, and the final eight cents increase will start October, 1959.

The Northwest dispute with IAM was settled without a strike but TWA mechanics late last week appeared prepared to strike for higher wages. However, union leaders here were confident further strikes would be averted as a result of the agreements reached by Northwest and Capital.

Supplemental carriers, in their protest to the Civil Aeronautics Board, suggested that strikebound airlines could still realize a profit by allowing the supplementals to use non-striking ticket and ramp agents. Such a plan, they contend, would remove an important roadblock to the supplemental carrier's handling of traffic generated by a strike.



American Installs Jet Handling Equipment

Ground handling equipment for American Airlines' Boeing 707-120 jet transports has been delivered to Love Field, Dallas, Texas. Units, costing a total of $66,058, include an air compressor cart (foreground), and, from left, center row, a lavatory cart, tow tractor and auxiliary power unit. At rear is a ramp sweeper. Not shown is a mobile passenger ramp.

Iranian Line Gains Solid Financial Status

By L. L. Doty

Teheran—Iran's place in the field of international commercial aviation hinges entirely upon the financial backing and credit rating of one man—a former statesman whose airline experience began only after he decided to organize Iranian Airways 12 years ago.

Reza Afshar, whose government career included terms as vice president of the Iranian parliament and as a member of the Shah's cabinet, lists himself on the company roster as president and managing director of the airline. He also is owner of every share of the company's outstanding stock. And, at 72, he is ready to pour more money into the airline he founded with a fleet of 19 Douglas DC-3s which he gained by out-maneuvering the Russian government.

That his credit rating is sufficiently strong to hold the Shah's support of the airline, is attested to by the fact that Lockheed Aircraft Corp. has offered him a $10 million long-term loan toward the purchase of a fleet of turboprop Electras, a credit position several U. S. airlines could justifiably envy. His devotion to the airline is evidenced by the fact he has never earned a profit on his investment, yet he is determined to expand the airline until it is operating out of the red.

Afshar told AVIATION WEEK he first became interested in airline operations when he discovered the Russians flying lend-lease DC-3s on a commercial basis throughout the Near East, and in Iran in particular, during the closing stages of World War II.

Soviet Penetration Attempt

As bitter foes of communism and traditional enemies of Russia, high-ranking Iranians feared a commercial invasion of their country by the Soviets following the end of the war, and Afshar interpreted the DC-3 operation as a vanguard of that movement. Iran, at that time, was occupied by British and U. S. troops in the south and by Russian troops in the north. The garrisons were to protect the supply line of lend-lease material flowing through Iran into Russia.

Although all troops were to have been withdrawn by March 2, 1946, the Russians were sending additional forces into Iran as late as October of that year and were lending support to the Tudeh party, local Communist-inspired political group.

Afshar learned from George V. Allen, ambassador to Iran between 1946 and 1948, that continued operations of the DC-3s by Russia for commercial purposes was contrary to the lend-lease terms under which the fleet had been loaned by the U. S. Similar problems were encountered by the U. S. in its attempts to get Russia to return lend-lease merchant ships.

Presumably seeking a diplomatic way of solving at least part of the problem, Allen suggested the U. S. might be willing to sell Afshar the airplanes out from under the Russians. Afshar promptly made a deal, although he had had no previous business experience and his only touch with communications had come through appointments as administrator of roads in Iran and as governor general of several Iranian provinces.

The Russians made no attempt to deliver the airplanes after the contract with Afshar was announced to them, and Afshar was forced to take possession of the fleet "as is" and "where is," the latter covering the span from Cairo to Teheran. He bought the 19 planes at what he terms "a pretty good price."

Raising Capital

Afshar immediately obtained the sole right to operate a commercial airline within Iran and then set about to raise capital to organize Iranian Airways. Within a few months, he had mustered enough backers with sufficient capital to start operations and had completed arrangements with Trans World Airlines to handle all maintenance and overhaul functions in Cairo.

By 1947, Afshar had grown dissatisfied with his unsuccessful attempts to bring about any unanimity of decision with his fellow stockholders, and he felt the TWA charges for technical assistance were "much too high." As a result, he bought out all the original backers of the company until he was sole shareholder and dropped the contract with TWA.

REZA AFSHAR

Today, the airline is operated essentially by Americans based in Teheran. All pilots are Americans; all copilots are Iranian. Maintenance and overhaul functions are generally supervised by Americans, although 83 of the 91 mechanics are German.

Major overhaul work is not yet handled by the airline, but Afshar thinks the day is not far away before the company will become independent of outside help. Under a five-year contract, Transocean Airlines is handling the company's major overhaul work.

Iranian Airways' fleet now consists of eight DC-4s, three Convair 240s and three Vickers turboprop Viscounts. Afshar is now negotiating with Fokker for the purchase of five Friendship F-27 turboprop transports and hopes to add Lockheed Electras to the fleet if he can expand the sphere of the company's operation to the extent he wants.

At present, the airline operates as far into Europe as Frankfurt, a route rich in cargo traffic. Afshar now looks to London, Paris and Rome as the next terminal points to be added to the carrier's system. Biggest traffic areas are presently from Teheran to Beirut, Baghdad, Karachi and Kabul.

Expansion Plans

Eventually, Afshar plans to extend the Teheran-Frankfurt route to New York via London but recognizes the need for more experience and faster equipment before he makes a bid for the transatlantic route. Immediate goal is an expansion of routes throughout Europe.

Domestically, the airline is growing rapidly as an important adjunct to the nation's economy and joins 17 cities with Iran. Operating as a private enterprise, the carrier fits into the Shah's plans to develop an internal communications system that will operate free of foreign influence.

The country's road-building program is being sponsored by the public treasurer. A transcontinental railroad which operates from Bandar Shahpur on the Persian Gulf to Teheran and northeastward across the Elzburz mountains to Bandar Shah on the Caspian Sea took 15 years to complete and was built entirely at government expense.

Nevertheless, surface transportation throughout Iran's mountainous and desert regions is haphazard at best, and Iranian Airways is filling a serious gap in the nation's commercial and trade

program. Afshar emphasized the economic expansion within Iran that has developed during the past 10 years and pointed to the population growth—from 15 million in 1946 to 20 million today—as major evidence of the need for a strong transportation system.

Traffic Growth

Last year, the airline carried 80,000 passengers. Afshar admitted this was an insignificant amount compared with traffic handled by U.S. airlines but noted that "for our airline, that volume of traffic is large and shows growth." Most traffic is now confined to business and government representatives.

To obtain high aircraft utilization as a means of holding down operating costs, Iranian Airways stresses charter operations as a profitable adjunct to its scheduled service.

American businessmen and U.S. government officials in Iran are taking full advantage of the charter service offered, Afshar says.

Iranian Airways operates from one of the most modern airports in the Near and Middle East. The 10,000 ft. runway of the Teheran airport is being expanded to 14,000 ft. in order to handle turbojets.

Despite the fact that instrument letdowns are necessary on an average of only about three days a year, an Instrument Landing System will be installed within the next 12 months. Within six months, the field will be equipped with terminal VOR.

Piedmont Begins F-27 Service; Load Factor Increase Anticipated

By Robert H. Cook

Winston-Salem, N. C.—Piedmont Airlines is anticipating record load factor averages for its system within the next three years as one of the rewards of integrating Fairchild F-27 turboprop transports into the company's present fleet of 21 DC-3s.

The airline has taken delivery on four of the aircraft in its $7 million order for eight F-27s and expects delivery on the remaining four by next month.

First scheduled service with the new aircraft was begun on Nov. 14 over a route connecting Cincinnati, Ohio; Lexington, Ky.; Bristol, Tenn., and the North Carolina cities of Winston-Salem, Greensboro, Raleigh, Fayetteville and Wilmington.

Designed specifically for the short stage lengths and small airport characteristics of local-service carrier operations, the F-27 is considered by Piedmont officials to be "tailor made" for the airline's 3,290-mi. route system, which has an average stage length of only 80 mi.

'Skip-Stop' Authority

While the company feels that the new aircraft can turn in an economical performance and high load factors on relatively short flights, it hopes for approval from the Civil Aeronautics Board for "skip stop" authority which might stretch the F-27's average flight into more profitable runs of 100-mi-plus.

Data filed by the local-service carrier with the CAB was based upon an assumption that it will dispose of its eight DC-3s by the end of 1961. Company spokesmen now say, however, that there are no immediate plans to sell any of the piston engine aircraft, since they might be needed if the Board approves any new route extensions for Piedmont.

Among the additional expenses Piedmont says it will incur with the F-27 are such items listed with CAB as a 26% increase in direct maintenance costs per hour as compared with the DC-3 and a 10% rise in landing fees for the larger aircraft.

The company also has signed an agreement with Capital Airlines for the 1,400-hr. overhaul of the F-27's Rolls-Royce Dart engines.

Cost of overhaul per engine was estimated at $12,000.

The company says, however, that greater payload capacity, passenger appeal and economical operation of the turboprop engines on the F-27 will not only cover extra costs but also aid in trimming operational losses attributed to the DC-3s.

Piedmont estimates it will realize a 51.42% load factor on its F-27s by next June 30 and a load factor of 55.24% by 1961.

Expected break-even load factor, based on present subsidy levels, is 48.5%.

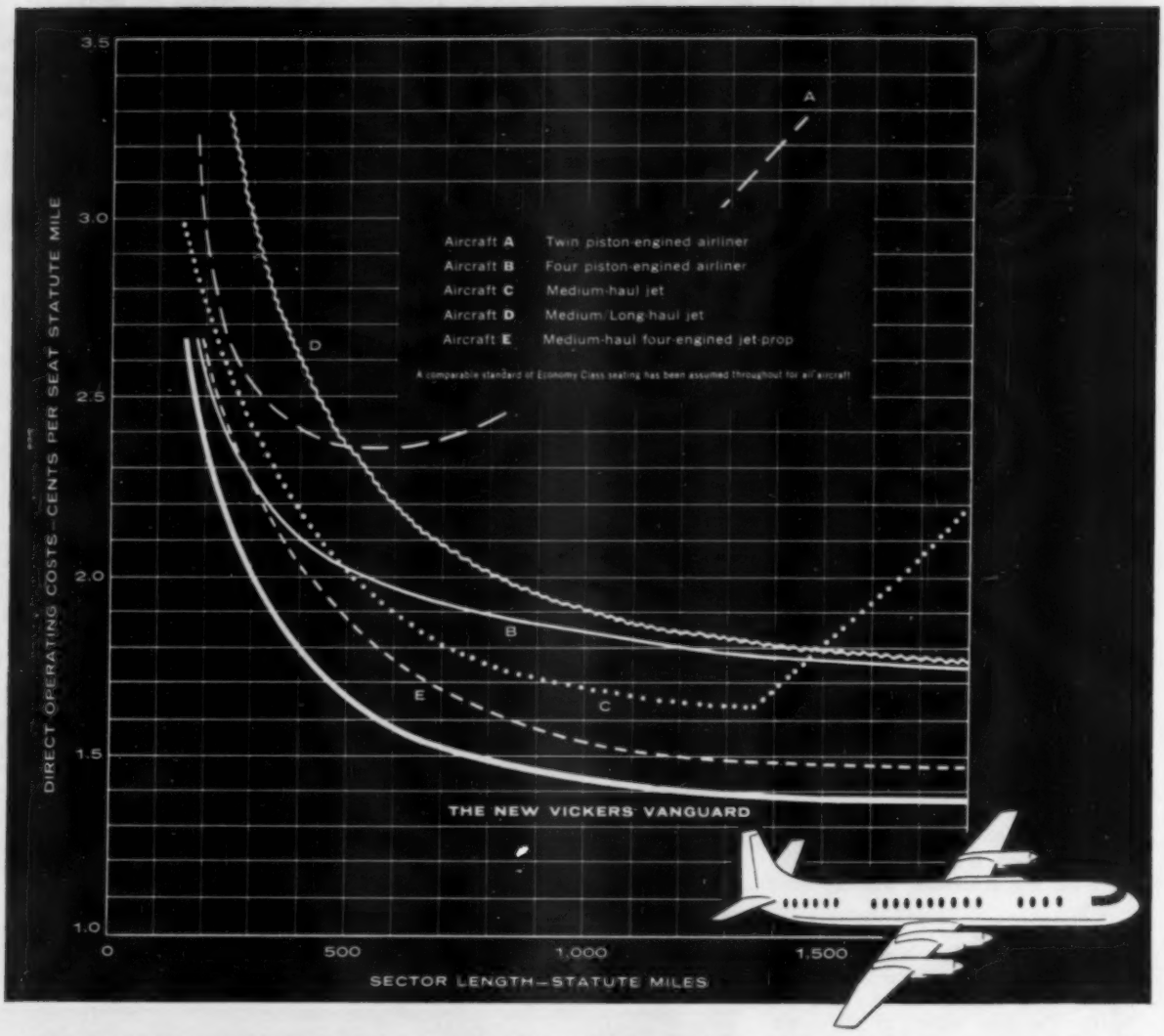
Actual load factor of the company's DC-3 fleet this year has hovered around the 50% mark and is expected to increase to 54.7% by 1961, according to figures filed with the Civil Aeronautics Board.

Direct operating costs, per available seat mile on the F-27, including flying operations, maintenance and a 10-year depreciation, has been estimated at 2.1 cents per mile as compared with the present 2.5 cents for Piedmont's DC-3 fleet.

With a mixed fleet configuration, the carrier estimates it will have F-27 revenue passenger miles of 60.9 million by June 30, and 70.8 million by 1961, based upon available seat miles of 118 million and 128,000 respectively. At the same time, the company's DC-3s are expected to generate 47.5 million revenue passenger miles and 53.9 million respectively over the same period. The DC-3 mileage is based upon available seat miles for this period of 88 million, increasing to 98 million by 1961.

Vickers Vanguard Starts Resonance Tests

First Vickers-Armstrongs Vanguard turboprop transport is undergoing resonance tests at Weybridge, England. Rolls-Royce Tyne (5,315 eshp. each) turboprops are installed. Aircraft is scheduled to make first flight next month. Front and rear sections of initial Vanguard are being fitted with British European Airways furnishings (AW July 7, p. 41).



AIRLINE REPORTS LOWEST SEAT-MILE COSTS

A recent impartial evaluation by one of the world's leading airlines showed that the new jet-prop Vanguard will offer the lowest seat-mile operating costs on all sectors from 200 miles to 2,000 miles. The Vanguard, with a maximum payload of 29,000 lb. and a 139-seat configuration, was compared to five other modern airliners for economy class jet age service—including British and American pure jets and jet-props.

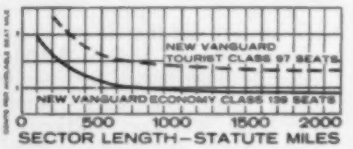
HIGHEST PROFIT POTENTIAL

To most American carriers in the jet age, the Vanguard will offer a profit potential *at least 35%* higher than that of any comparable airliner—and *twice* that advantage on economy configurations. Many factors contribute to Vanguard profitability on all ranges up to 2600 miles. Rolls-Royce jet-props have proved their reliability and ease of maintenance. Simultaneous on-and-off loading of both passengers and freight permits fast turnaround. On high-density routes, the Vanguard is the biggest profit-earner ever offered to the airline industry.

The Vanguard's large, well-balanced passenger/freight capacity makes possible high utilization and high profits even on off-peak services. Because of its smooth, silent comfort and speeds that will be competitive with jets on short-to-medium ranges, the Vanguard offers strong passenger appeal that makes for good load factors.

For detailed specifications and a cost analysis based on your operations, contact Christopher Clarkson, U.S. representative, 10 Rockefeller Plaza, New York 20, New York.

The chart at the right shows the Vanguard's direct operating costs, and is based on A. T. A. costing methods. The figures are representative for American carriers. Note that Vanguard costs will be about 2¢ per available seat mile on 100-mile sectors—and *under* 1¢ on all sectors over 900 miles.



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Travel Agents Urge Jet Sales Incentives

New York—Airline representatives last week were considering a plea by travel agents for higher commissions and other incentives to make the jet-age sales which most industry observers believe must come mainly from untapped markets. Proposal was before an Air Traffic Conference meeting in Houston.

Most airline officials agree that the travel agents, who now provide the bulk of international bookings and a healthy percentage of domestic business, represent an important part of the needed sales effort. But ATC's action on the American Society of Travel Agents' proposal may mark a critical point in long-standing problems in airline-agent relationships.

These problems were aired this month at ASTA's 28th annual congress here, at which Prof. Paul Cherington told the agents that radical new marketing programs are needed to provide traffic to fill the jets.

Agents' Role

Cherington, author of the Cherington Report to Elwood Quesada on airline problems (AW Aug. 11, p. 28), said the travel agents will play a significant part in such new programs. But it appeared, during the week-long conference, that airline-agent cooperation in developing the traffic was being considerably obstructed by the following major points:

- **Rate of commissions.** Agents complain that increases are urgently required to offset rising costs and to provide incentive for wider promotional and sales efforts.
- **Credit sales.** Agents violently oppose any credit plans that involve charges which must come out of their commissions. They would also like domestic air travel plan sales to be commissionable, which is not now the case.
- **Charter sales.** ASTA reports that the volume of special group charters on the North Atlantic now represents more than a fifth of all air traffic carried on the route. Much of this traffic, the agents believe, consists of artificial rather than bona fide groups eligible for charter rates and the general public is discriminated against.
- **Commercial accounts.** Airlines generally prefer to sell this business through their own personnel rather than pay an agent's commission for it. The agents, on the other hand, protest the carrier "competition" in commercial sales and insist that an agent is an agent for all the varied categories of passenger sales.

The commercial business, however, is generally conceded to be relatively minor in growth potential. Pleasure travel is the category in which the great increases of new business will have to be developed to exploit jet-age capacities.

Without substantial increases in traffic, Cherington pointed out to the agents, "the airlines' future looks bleak." He does not believe that the solution is to place heavy reliance on the continuation of past growth trends, or to suppose that the superiority of jet travel will automatically generate the needed traffic.

Cherington noted that some increases can be expected in business travel, but that they will keep more or less in step with the economy. The days of heavy diversion from Pullman travel are over because most of this traffic is already diverted—there are only 4-5 billion Pullman passenger miles left.

The domestic pleasure and vacation market, however, is virtually untapped by the airlines, Cherington indicated. Relatively few Americans go to their vacation destinations by air.

Cherington offered a five-point program for opening up this new market: a "desperately needed" broad program of market research, in which the airlines have been "derelict" both in doing too little and in directing what they have done to competitive ends; new price inducements in the airline fare structure in the form of promotional fares, particularly for off-peak travel; "high impact" advertising to "get people thinking about vacation trips in the same way they think about new cars or a new TV set"; greatly improved budget payment plans for air travel vacations; and "grass roots solicitation" of new business.

Advertising Criticized

Cherington said he was discouraged about the present state of airline and travel advertising, which is "frankly competitive" and addressed almost exclusively to the person who has already made up his mind to fly. He said that "surely in the advertising business somewhere, there should be enough talent to come up with a high impact program . . ."

Concerning the present mechanics of pay later plans, Cherington said he recently called a number of domestic airlines in Boston to inquire about budgeting a trip to Miami for his wife and himself. The results, he said, were that "I could have got on public welfare easier, quicker and with less suspicion."

ASTA Executive Vice President Raymond H. Hering told the agents at their conference here that they "are now at the crossroads" in their relations with the carriers and "we shall aggressively prosecute our case." He predicted that unless agents' complaints were answered there might be a long and costly battle which might affect the conference system itself.

International Air Transport Assn. at its recent meeting in Cannes turned down a travel agent request for increased commission, Hering noted. The request, now under consideration by the Air Traffic Conference, is concerned with domestic traffic.

ASTA recently asked the U. S. Maritime Commission for an informal investigation of practices of the Transatlantic Passenger (steamship) Conference, objecting particularly to the rule of unanimity and the secrecy of proceedings. If continued friction led to a formal request from the agents, the conference structure itself might be legally challenged. ASTA's recourse against the airlines could be a similar request to Civil Aeronautics Board for an investigation of the entire conference setup, Hering told AVIATION WEEK.

Amity Hoped For

However, the ASTA official stressed his hope that amicable solutions would be found between agents and carriers. The proposal now under consideration by Air Traffic Conference calls for a basic commission of not less than 10% on all sales whether cash or credit, a supplemental commission on prearranged tours sold by stipulated promotions, and specifies that the travel agent "shall be an agent for all categories of passenger sales"—i.e., including commercial accounts.

Figures submitted by ASTA with the proposal indicate that 25.1% of the domestic revenue of 11 major trunk air carriers in 1957 was provided by travel agents, or a total of $322 million. Foreign revenue provided to these trunks by the agents during 1957 was $63 million, or 51% of their total, according to the ASTA analysis.

Travel agents, according to ASTA, booked 70-75% of last year's international airline business.

Commission rates at present are 10% for sales involving package tours, whether domestic or international; 7% for international point to point air transportation sales; 5% for domestic point to point sales.

Regarding charters, ASTA officially deplores the trend of air and sea carriers "utilizing an increasing percentage of their transport capacity in the movement of artificially constructed 'groups', incorrectly and misleadingly called 'charters.'" The agent association calls

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Boeing Turbo-Starters, installed in half-ton panel trucks, are available to airlines and to military installations. For complete details, write: Mr. J. C. Anderson, Sales Manager, Industrial Products Division, Dept. AW-1, Boeing Airplane Company, 200 West Michigan Avenue, Seattle 24, Washington.

air transportation on the North Atlantic the "most flagrant case" of charter activity and says the volume of such traffic is now in excess of 20% of all traffic carried. Contending that granting a "discriminatory" privilege to groups "so large as to be indistinguishable from the public itself" is an imposition on the rest of the traveling public, a recent ASTA resolution calls upon the carriers, CAB, Maritime Board and others to prevent such practices or to generally lower fares.

ASTA generally supports CAB Examiner James S. Keith in his recent report to the Board in a case concerning the appointment and retention of travel agents by air carriers through their Air Traffic Conference. Another agent group, Travel Agents Guild of America, along with an agency, challenges in this case the Board's authority to approve ATC agreements regulating appointment of agents.

The case involves the present system under which airlines, through the Agency Committee of the traffic conference, pass on the qualifications of travel agents to get on or stay on the approved ATC list. TAGA seeks to let each carrier act individually in appointing agents; CAB's counsel wants to continue the system on a revised basis; and ASTA, an intervenor in the matter, favors continuing the system more or less as it is.

The examiner has concluded that the conference system "offers and will continue to offer significant advantages not only to the domestic certificated airline industry but to the traveling public and travel agents as well . . . (but) there are features of the system . . . which are repugnant to the interests of travel agents and which adversely affect them."

The conference resolution concerning the appointment of agents, with its amendments, is not adverse to the public interest, the examiner found, provided certain revisions are made. These include dropping the requirement that an applicant agent must be sponsored by a member airline to qualify; that reasons for rejecting applicants must be recorded and rebuttals allowed; and the "need" of carriers for agency representations in a given area not be considered in the appointing of new agents.

Middle East Air-Sea Interline Pact Signed

Middle East Airlines and American Export Lines have signed an interline agreement for air-sea interchange on the two company's routes. Principal route involved is between Italy and Lebanon. American Export operates service from the U. S. to Genoa and Naples, linking with the airline's Rome-Beirut flights.

East Germany's Jet Buildup Would Increase Production and Traffic

Bonn—East German aircraft designer Prof. Brunolf Baade says his country's industry will produce jet aircraft both for domestic and foreign airlines.

Baade revealed a major structural change in the medium-range BB-152, now designated the 152, which is six months past its original initial test flight date. He spoke at the Second Polytechnic Convention of the Dresden Technical University.

A tricycle landing gear with nose wheel on the fuselage and main landing gear on the engine nacelles will replace the tandem undercarriage and retractable wheels at the wingtips incorporated in the first two prototypes (AW May 12, p. 41). The new prototype is now under construction.

Although not yet officially announced, AVIATION WEEK has learned that the first prototype will not be flight-tested before the end of the year.

Reasons for Changes

Baade, one-time Junkers designer who went to the Soviet Union after World War II, said the modified undercarriage made available a larger space for the passenger cabin. Elimination of the retractable wingtip wheels was to ensure against these wheels running into soft ground on either side of the runway during landing.

Cruising speed of the 152 is between 500 and 530 mph. and new gross weight is 102,300 lb.

The 152 is designed to use airfields in International Civil Aviation Organization Class F. Second 152 prototype is being used for fatigue-testing to destruction.

Baade said it is essential that the greatest effort in East Germany be concentrated on construction of medium-range aircraft whose performance is at least equal to other types available on the world market. This means cruising speed of 450 to 500 mph., a maximum range of 1,250 to 1,750 mi., capacity of 60 to 80 passengers and economical operation. Due to shortness of runways generally in use in Central Europe, the planes would require a large reserve of engine power.

Baade said the German Democratic Republic expected to purchase special-purpose machine tools of various kinds outside the country in order to save time and money. But he maintained that East German aircraft personnel, after a long period of inactivity after the war, had gained valuable experience through license production of the Russian IL-14. Cabin equipment in the IL-14 was modified extensively and the number of passenger seats increased from 18 to 26.

In the case of the new 152, Baade said the first wind tunnel and fatigue-testing laboratories were erected in the immediate vicinities of Klotzsche, about five miles north of Dresden, and Pirna, about 10 mi. south of Dresden. Later, a state-owned research center and technical institutes there were opened. The works at Klotzsche are devoted to aircraft construction and design, while those at Pirna are concerned with construction and design of jet engines.

Baade, who was recently named technical and research director of the reorganized East German aircraft industry, said the industry is concerned only with civil aviation since no military craft are being produced in the Republic.

In a paper on "fundamentals for the economic operation of aviation traffic in the German Democratic Republic," Prof. Gerrit Schimkat of Dresden said East German Lufthansa should build up a fleet of 120 aircraft consisting of two short-distance types, two medium-distance types and a long-distance type. Only the long-distance type would be purchased outside East Germany (presumably from the USSR) said Schimkat. When the buildup is completed, Schimkat said, the East German airline would employ about 15,000 persons.

To facilitate air traffic, Schimkat proposed the construction of 36 short-runway airports within the boundaries of the Republic. He said that in estimating the number of miles flown in a year by national carriers, divided by each nation's total population, the U. S. showed a ratio of 268, the USSR 50, West Germany 15 and East Germany four. Turning to costs, he said a gallon of fuel in East Germany could be figured at the equivalent of 32 cents per U. S. gallon. Once pipelines were installed, he maintained the price could be halved.

In addition to 20 papers devoted to aviation and its allied fields, 230 were presented in fields of polytechnology at Dresden. There were about 500 visitors from East Germany and a handful from West Germany in reciprocation for invitations to the West German convention of the Scientific Society for Aviation (Wissenschaftliche Gesellschaft Fuer Luftfahrt) in Stuttgart last month. The Dresden conference attracted 100 visitors from Bulgaria, Czechoslovakia, Finland, India, Yugoslavia, Austria, Poland, Switzerland, USSR, Hungary and Communist China.

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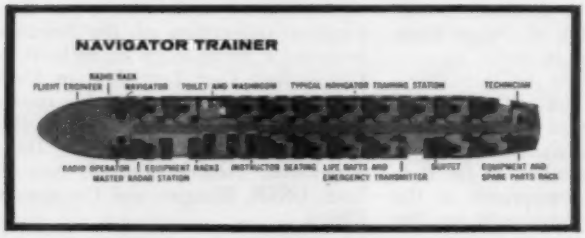
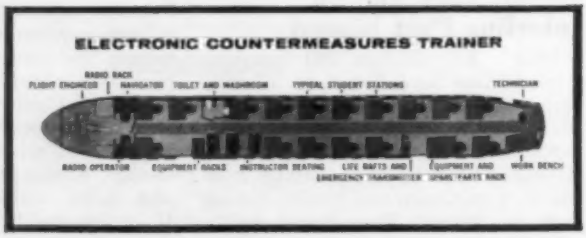




SHORTLINES

▶ **American Airlines** flew 758,000 passengers a total of 465 million passenger miles during October for 4.2 and 6.7% increases respectively over October, 1957. Air freight carried was up 28.4% over last October at 9,886,000 ton miles; total mail, express and freight figure showed a 25% increase.

▶ **Civil Aeronautics Administration** has invited bids for the paving of three runways at the new Washington International Airport at Chantilly, Va. The bids, to be opened on Dec. 19, must meet plans and specifications for the paving of two north-south runways, each 11,500 ft. long and 150 ft. wide, grading and draining of one east-west runway 10,000 ft. long and 150 ft. wide, and the paving of 75-ft.-wide parallel taxiways, including six high speed taxiway turnoffs on each of the three runways and the paving of holding pads. Plans and specifications require that all work be finished 600 days after the date of the notice to proceed.

▶ **CMA, Mexicana de Aviacion,** last week was scheduled to begin the first nonstop flights between Los Angeles and Acapulco. CMA will use Douglas DC-6s and Bristol Britannia turboprop transports over the route.

▶ **Flying Tiger Line** revenues for air freight during October showed a 34% increase over 1957, totaling $1,227,149, a domestic record for the carrier.

▶ **Hawaiian Airlines** reports net earnings of $503,995 for the third quarter of 1958. After payment of interest on debt and accrual of territorial income tax liability, net earnings were $435,768, or $1.25 per share.

▶ **Pan American World Airways** reports that total operating revenues for the third quarter of 1958 totaled $91,680,000, a slight gain over last year's third-quarter figure of $90,954,000. Passenger revenue was $72,132,000, up 1.7%; freight revenue up 8.4% at $8,728,000.

▶ **Seaboard & Western Airlines** net income for the third quarter of 1958 reached $1,252,477, wiping out a loss of $1,223,269 sustained during the first half of the year. Third quarter earnings were equal to $1.25 per share.

▶ **United Air Lines** operated 7,076,000 freight ton miles during October to equal the company record set in September. Revenue passenger miles were 458,900,000, up 11% over the same period of last year; mail ton miles were up 16% at 2,872,000.

AIRLINE OBSERVER

▶ Watch for Japan within the next three weeks to formally accept terms offered by the U. S. in recent negotiations covering the bilateral air transport agreement between the two countries. As a result, Los Angeles will be added to Seattle and San Francisco as ports of entry into the U. S. for Japan Air Lines Pacific routes. Although Japan had fought to win Los Angeles as a co-terminal with San Francisco, it has now decided to accept Los Angeles as a new terminal point on its system without rights to operate beyond. However, the decision can be considered as a temporary one, since Japan will undoubtedly renew its demands for additional U. S. routes in 1960 when Japan Air Lines plans to begin service with its Douglas DC-8 turbojet transports.

▶ **Passenger load factor of 58.96% for domestic trunkline carriers in October represented the first monthly increase in 15 months. During the same period, revenue passenger miles showed a larger percentage increase than has been recorded in any month this year since January. At the same time, the increase in available seat miles during October was a negligible 1.2%. Most observers, however, feel that the leveling-off of the volume of seat miles offered by the airlines is a temporary situation and that the historic upward trend will be resumed early next year.**

▶ Traffic Conference of International Air Transport Assn. will reconvene Jan. 13 in a final move to resolve the jet surcharge issue (AW Oct. 27, p. 37). Place of meeting has not yet been designated. Chances that a jet surcharge will be adopted to become effective April 1 are strong. Compromise proposal that Pan American World Airways and British Overseas Airways Corp. operate jet flights without an economy plan as a means of creating a fare differential will be shelved because of the large volume of traffic the economy plan—68% of all traffic during July, August and September—is now attracting on the North Atlantic.

▶ **Personnel furloughed by the International Assn. of Machinists strike against Capital Airlines are protesting the right of a minority union to take an action that keeps a majority of the company's personnel off the payroll. Attempts by local IAM leaders to assuage members of other unions have failed, and the Capital strike may open the way to closer cooperation among various unions in future labor problems. Out of approximately 7,700 Capital employes, close to 5,000 members of unions other than IAM have been furloughed by the five-week strike. About 300 managerial and non-organized personnel, who are retained on the company's payrolls, have been forced to take a 20% pay cut as a result of the strike.**

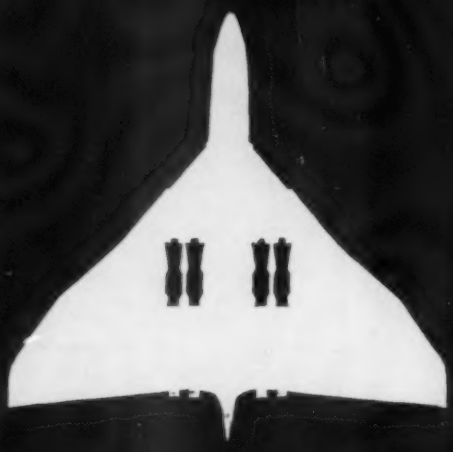
▶ Military Air Transport Service has awarded contracts totaling $851,732 to four carriers for cargo airlift in the Pacific area during the month of November. Out of the 14 companies which submitted bids, contracts were awarded to Transocean Air Lines, United States Overseas Airlines, Overseas National Airways and Flying Tiger Line.

▶ **Russia now has four versions of its I1-18 Moskva turboprop transport under production for export purposes.**

▶ Domestic airline stocks listed on the New York Stock Exchange are showing new strength in the generally rising market. With few exceptions, substantial gains have been recorded by airline stocks during the past two weeks in response to the expanding market.

▶ **Boeing's numerical designations of its 707 turbojet transports indicate not only model type of the aircraft but powerplant used and the airline operating the aircraft as well. For example, the "400" series in the intercontinental group designate aircraft powered by Rolls-Royce Conway engines. The "300" series are powered by Pratt & Whitney J75s. The last two numbers within the series number indicate the airline purchasing the aircraft. The 707-430 is the Conway-powered Boeing operated by Lufthansa; the 707-420 is the same model operated by British Overseas Airways Corp. Planes in the "100" series such as Pan American's 707-121 and American's 707-123, are powered by the Pratt & Whitney J57.**

THE BRISTOL OLYMPUS TURBOJET ENGINE



BRAIN POWER

THE PROBLEM. To engine a projected long-range high-speed bomber (later to crystallise as the Avro Vulcan), a concept steering turbojet development into new realms of high altitude operation and massive thrust.

THE ANSWER. The Bristol Olympus, one of the world's most powerful aero-engines. Olympus progressed from the Mk 101, type tested in 1954 at 11,000-lb thrust, to today's Mk 201, type tested at 17,000-lb thrust. Both these figures were attained *without* reheat and with *good* fuel consumption and impressively high thrust/weight ratios.

Signs of success

To the engineer, the Olympus represents the successful implementation of a theory: it pioneered the twin-spool principle with its promised bonuses of lower fuel consumption at both low and high altitudes, higher power, and rapid acceleration even at extreme altitudes.

In RAF service, however, the Olympus has achieved al this and more. Not only as an engine officially complimente for setting new standards of handling at high altitudes but as a "fit and forget" engine; as an engine sharing wit the Avro airframe the highest official praise as the aircraf suffering the fewest teething troubles of any introduce into the RAF in ten years.

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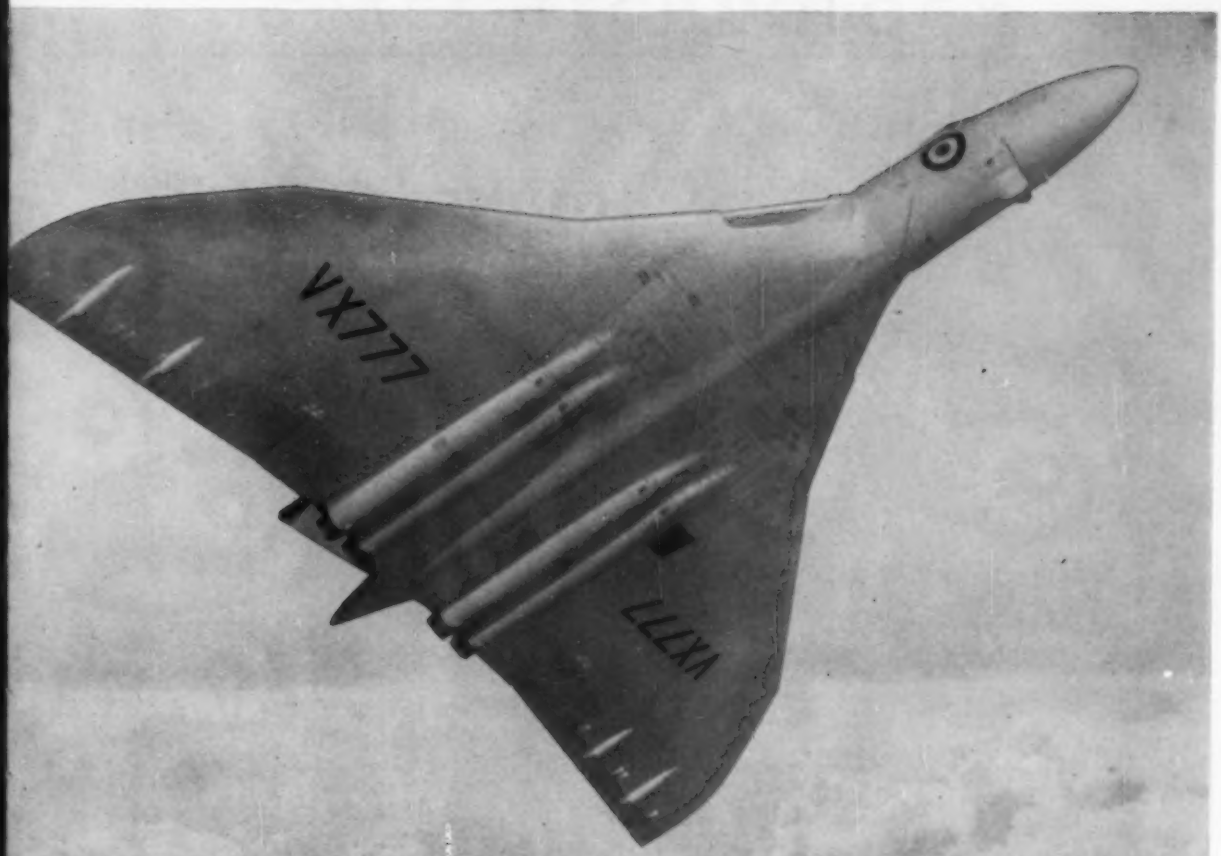

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Space Vehicle Escape Methods Studied

By Craig Lewis

San Antonio—Development of manned vehicles for space flight will bring with it problems of escape and rescue that call for solutions involving new techniques and hardware.

These problems are largely unsolved right now, but some of the philosophy emerging from work on them was evident in discussions of escape and rescue here during the Second International Symposium on the Physics and Medicine of Atomosphere and Space.

Current philosophy on escape systems appears oriented toward making maximum use of the vehicle hardware and away from design of elaborate separate escape devices. Alfred M. Mayo of Douglas Aircraft Co. said aircraft experience indicates maximum use should be made of existing structure and equipment in the escape system. To achieve this, escape requirements must be integrated with total vehicle requirement and the addition of single purpose devices should be minimized.

Outlining various parameters of human tolerance, Mayo said an escape system designed to maintain under extreme conditions an internal environment within survival tolerance of the crew, could provide maximum practical protection. But such a system could not protect the crew against all possible accidents; meteoroid collision, violent explosion or extremely high radiation concentrations are the kinds of conditions which call for a means to prevent them from occurring rather than for an escape system.

Space operations create a variety of escape problems, a number of which may be solved by an extension of escape techniques for very high performance aircraft. These fall in the area of launch, atmospheric flight and landing, and before a vehicle goes into orbit or reaches escape velocity.

In this area, Mayo feels the escape section of a vehicle should have the structural integrity and stability, plus automatic control and self-contained propulsion, to separate and stabilize its path, decelerate and protect its crew during and after landing.

High cost of carrying weight in early space vehicles means weight must be saved to a greater extent than in aircraft systems, so Mayo said an escape system for ground and atmospheric phases of space flight should be the smallest practical part of the space vehicle in order to minimize the size of separation propulsion systems and deceleration devices and to make relatively high load attenuation feasible.

Escape unit should be located so explosions will aid in separating the unit, rather than trapping it. Separation propulsion should push the escape unit far enough from the primary vehicle to keep it clear of residual fires or secondary explosions. Over-all vehicle should be designed for maximum separation and structural attenuation of explosions or forces developing from failures in the fuel and propulsion systems.

Velocity attenuating and temperature control requirements of the escape section should make maximum use of available structure and equipment, Mayo said, and should depend as little as possible on extra deceleration and control devices designed for emergency use only. He also advised the use of shape controls, such as blunting, and absorption of heat by endothermic chemical reactions and by proper selection of surface materials for normal re-entry use.

Moving into the area of orbital and escape speeds, the vehicle acquires a new set of escape problems. Here the escape unit will have to provide the same protection against radiation and meteoroids and the same internal environment as the primary vehicle. Distance creates communication problems in locating and retrieving escape unit.

Adequate compartmentation, escape air locks and emergency oxygen sources are needed to permit temporary evacuation of a damaged or leaky compartment, and repair vehicles or emergency clothing will be needed to allow repair work in unpressurized areas.

Mayo pointed out, however, that high gravitational levels don't dictate minimum separation thrust levels or add high structural loads as they do closer to the earth.

In free space, Mayo said, the escape vehicle should be the largest part of the space vehicle system that would permit separation of a dangerously malfunctioning component. Thus, provision for jettisoning of potentially dangerous equipment like nuclear reactors, propulsion systems or toxic fuel might be a more practical escape approach than use of a minimal escape unit required to meet atmospheric flight conditions.

In such a case, Mayo points out that emergency communication systems would be essential to avoid loss of space crews that had survived an accident.

Timely information for decision to escape and controls for initiating it are needed, and Mayo feels such displays and controls should be integrated into the over-all vehicle display and control system. Information provided should take full account of the capabilities and limitations of the human operator so the greatest practical use can be made of human decision. Automatic safety systems can take over in emergencies requiring response faster than human capability or where loads applied to the vehicle are likely to have incapacitated the crew.

Mayo emphasized that automatic systems can be relied upon only for emergencies "which are sufficiently predefined to permit automatic system progamming."

A high degree of automation was favored by Robert M. Stanley of Stanley Aviation Corp. in a paper prepared for the symposium. Because of the uncertainties of human reaction to emergencies, Stanley said it appears preferable to have as much of the escape as possible carried out at least semi-automatically in obedience to a command, either from the crew or "other competent button pushers."

Other than giving the crew a "panic button" to push, Stanley said, the escape cycle should be fully automatic. "And I am not so sure but what the panic button itself should be deactivated during a major portion of the flight."

For escape during an emergency on the launch pad, Stanley said, existing ejection seat types could be adapted for use in conjunction with a fast-opening parachute. An ordinary ejection seat would be sufficient for escape up to about 50,000 ft., and an encapsulated seat would do the job up to 100,000 ft. he said.

Stanley pointed out, however, that the encapsulated seat could not stand up under re-entry loads, and that its usefulness would be limited to the first minute after launch and the terminal phase after the space vehicle had slowed to Mach 2 or less.

Turning from special escape devices, Stanley concluded that the final stage of the space vehicle itself is the most attractive escape system. Final stage would need a capability for low-altitude separation while on or near the launch pad, and this capability would extend through the atmospheric flight phase. Space vehicle would be the best refuge

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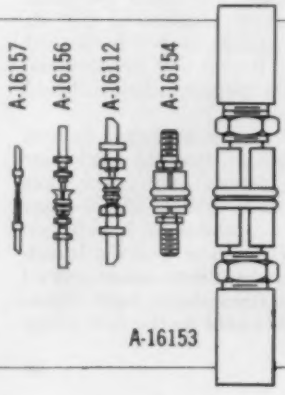

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for the crew during re-entry, and it could be provided with an emergency parachute landing capability.

Discussing the role of the final stage vehicle as an escape system in the event of a launching accident, Stanley granted that it would take vastly more energy to eject than would be needed for a man in an ejection seat. But he pointed to the advantages of having the crew remain at flight stations, ready for any low-altitude emergency and with no pre-escape preparations demanded.

Escape could be effected by the crew, by command from the launch crew or by automatic detection means in the space vehicle itself. Selection of the thrust vector could be pre-programmed without interfering with the reliability of the energy source for later use in maneuvering control.

Stanley observed that an escape capsule could be designed which would be smaller than the final stage and thus offer less mass to be propelled from the launch site. He said the problems of separation are great, design complexities formidable, and "it seems that for a given expenditure of energy and for a given standard of reliability, it would be far more fruitful to make the final stage vehicle perform the entire escape function and to give it the capability of escape, even though it, itself, is battered and broken and no longer useful as a flying machine."

For rescue and retrieve missions in space, Norman V. Peterson of Lockheed Aircraft Corp. Missile Systems Division outlined a pattern of approaches for the area between the earth and the moon. He said interplanetary missions will dictate the use of vehicles with redundant systems.

Krafft Ehricke of Convair-Astronautics also pointed out the need for stand-by systems for long-term flights and said the logical answer is use of a secondary vehicle.

Peterson pointed out that rescue missions will be involved with urgent emergency conditions where short flight times will be called for to avoid crew catastrophy. Retrieve missions involve less urgent conditions and permit low energy flight paths for intercept and retrieval of crews or payloads.

Achievement of manned orbital capability will permit construction of large satellite facilities in orbit and also provide the capability to maintain, repair and modify complex satellite devices, Peterson said.

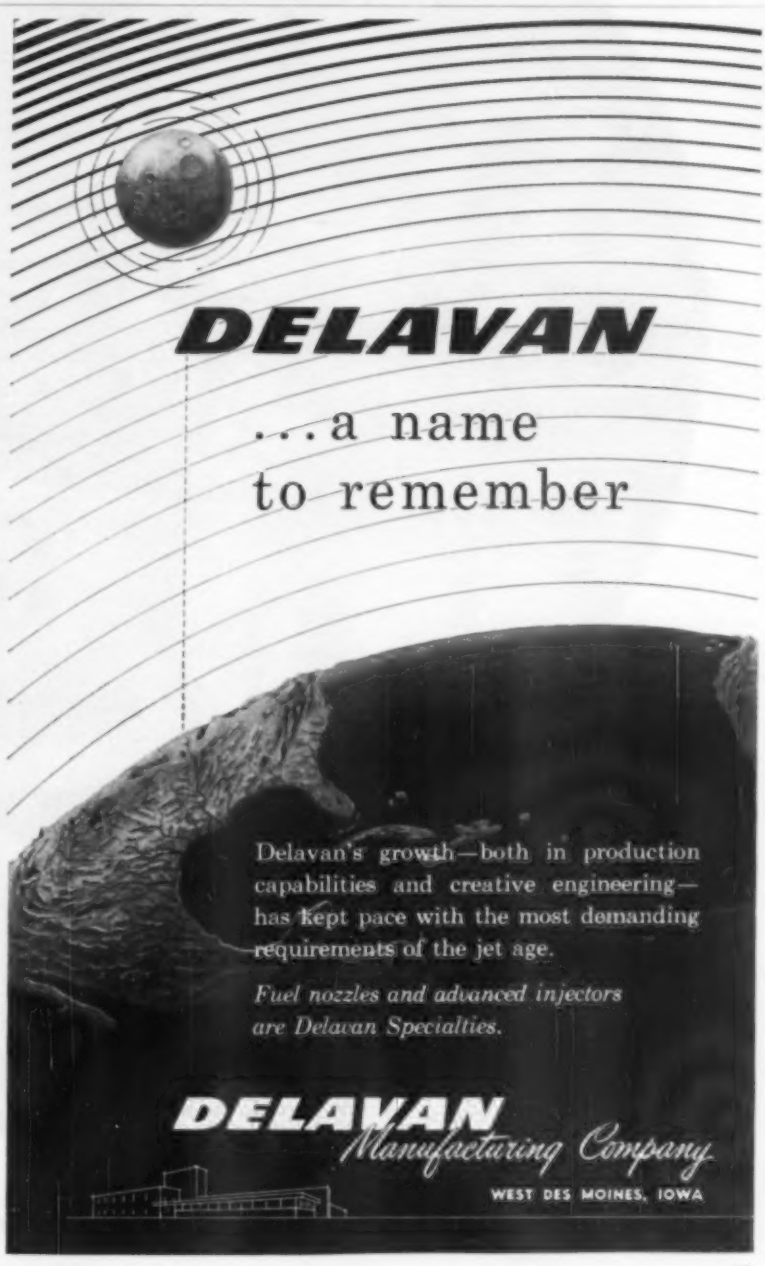
Greatest concentration of space traffic probably will be in the close-orbit area, Peterson said: "Vehicle traffic, including surface-to-orbit, inter-orbital transfer, and recovery, will pose navigational problems. System failures during thrust maneuvers will pose escape and survival problems requiring implementation of rescue and retrieve emergency operations."

For rescue and retrieve missions in the close-orbit area, Peterson suggests both ground-based and satellite-based emergency vehicles. He concludes that satellite-based rescue and retrieve vehicle systems permit more flexible operation than ground-based systems.

Discussing some of the problems of these systems, Peterson said that determination of the severity of emergency conditions would be difficult and determining the orbital characteristics of malfunctioning vehicles might require satellite-based tracking systems. Rotation of the orbit plane and changes in orbit plane inclinations require large expenditures of propellant, and use of separate emergency systems in each orbit plane would be required.

Short time paths for inter-orbital transfer call for a large expenditure of propellant regardless of orbit or altitude, he said. Minimum energy transfers require longer transits, and thus the more leisurely retrieve missions can easily be performed, even for a broad range of inter-orbital transfers.

Peterson said that, due to errors in determining target orbital characteristics, interceptor mid-course and terminal guidance corrections will be required.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Missile Lessons Have Application To Space Aeroelasticity Problems

Ft. Worth—Although new problems of aeroelasticity are arising with the advent of space flight, many of the basic tools and viewpoints developed to cope with aerodynamic forces will apply to this new environment.

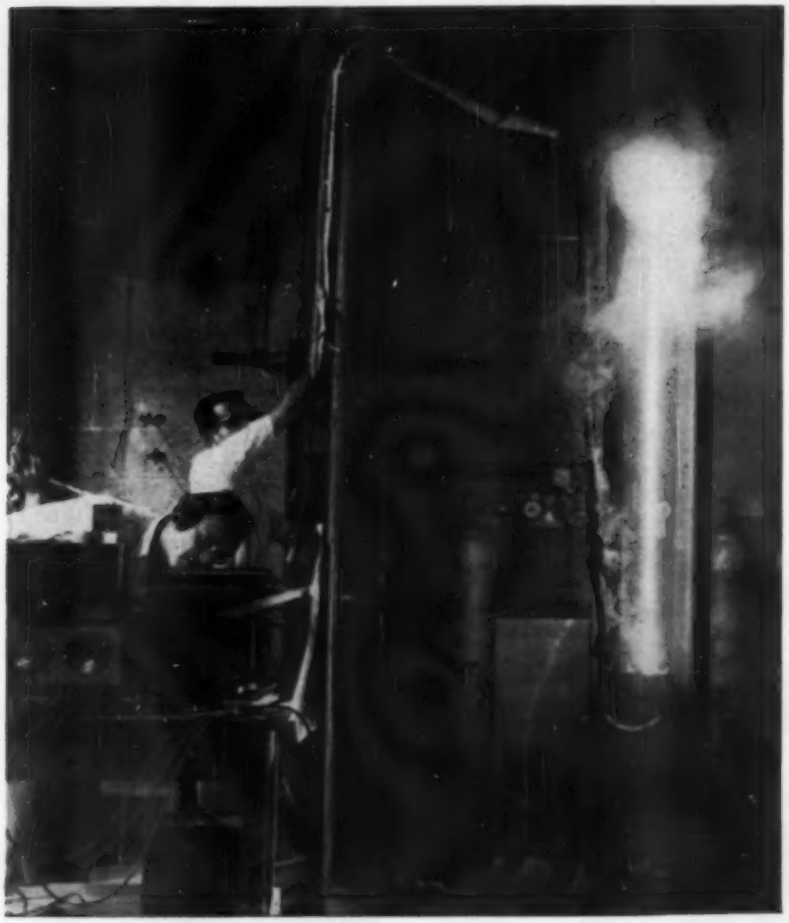
This forecast was made by a panel at the first Institute of the Aeronautical Sciences national specialist meeting on dynamics and aeroelasticity.

New and different types of equipment, along with a new environment, are involved in space flight, and Millard V. Barton of Thompson-Ramo-Wooldridge Corp. reminded the IAS group that a number of interacting forces are involved in the complex vehicles. All these forces must be considered as a unit in dealing with the problems involved.

Space vehicles will encounter the aerodynamic forces which formerly dominated aeroelastic problems only briefly in aircraft flight paths. But the nature of the vehicles themselves will create new problems. Very thin tank structures which lose possibly 90% of their weight as fuel burns are the basis of a whole missile system, and this new type of structure involves new forces and flight conditions.

Liquid-fueled missiles, which will serve both as weapons and boosters for space vehicles, are subject to shifting loads as their fuel burns. Thus frequencies change, and all frequencies must be designed for because all will be excited during the flight regime. Solid fuels also present problems, including fuel overshoots.

During the flight of a missile, aeroelasticians must be concerned with the



Scientists Conduct Ablation Tests

Graphite-tube furnace is used for ablation tests of structural plastics under re-entry conditions at Wright Air Development Center by Cornell Aeronautical Laboratory scientists.

PUMP PRIMERS

by

Arthur A. Nichols

"But, Where Can We Put The Lube Pump?"

This is a problem that often arises after a drive, auxiliary power source or gear box has been designed. Fortunately, it's a problem that the Gerotor pump is uniquely qualified to solve.

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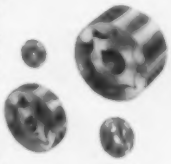

Fig. 1. Varied sizes make Gerotors unusually adaptable to space and capacity requirements.

Further space-saving adaptability stems from the fact that Gerotor pumps, unlike conventional gear pumps, require only a single shaft. This means that Gerotor elements of different capacities can be stacked along a single shaft in ported compartments within a single housing and mounted on a single AN pad to perform such multiple pump functions as: lube, scavenge, boost, etc. *(Fig. 2)*. Such compactness allows pump configuration to be adapted to gear box or other mechanism geometry. A multiple-function Gerotor pump can be submerged in a sump, which may be part of the pump housing.

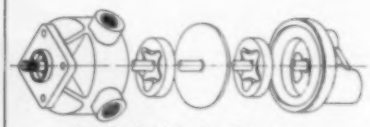

Fig. 2. Multiple function pump

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forces involved in engine vibration, maneuvering and gust loads, separation loads and control movements. Liquid fuel sloshing is a problem with the control loop.

Flame vibration can cause troubles, and noise vibration may be a problem with space vehicles. Noise vibration is a problem now with jet aircraft, but not with ballistic missiles because they are expendable. But as rocket size increases, so does noise and the fatigue problem that accompanies it. This could be an item of concern in a space vehicle that is planned for a fairly long, useful life.

First vibration problem in missile development was panel flutter in the fins of the German V-2 at the World War II missile site at Peenemunde, according to Phillip W. Zettler-Seidel of Army Ballistic Missile Agency. He pointed out that this problem disappeared as fins disappeared from missiles, but he said that as missiles grow larger and their shells thinner, new problems develop, and panel flutter in missile bodies may become a serious problem in the future.

Zettler-Seidel also observed that a feedback problem arises as missile size grows and there is more interaction of natural bending frequency with control frequency.

Discussing the problems of space flight in general, R. L. Blisplinghoff of Massachusetts Institute of Technology pointed out to AVIATION WEEK that there are a number of interacting internal forces in a vehicle which the aeroelastician must consider. These include elastic and plastic forces, control and guidance forces, inertial forces and propulsive forces. Then environmental fields act on the vehicle externally.

Until recently, aerodynamic forces were all the aeroelastician had to be concerned with, but in space the fluid media forms just part of the environment acting on a vehicle. Other elements which must be reckoned with are meteoric showers, cosmic radiation, gravitational forces and the electromagnetic field. Soft X-rays, thermal radiation and magnetohydrodynamics (AW May 12, p. 48) are further environmental considerations.

The group was warned that it faced a new type of job which called for new approaches, particularly in preliminary design. In trying to take large steps, engineers will have to be ingenious and anticipate problems and deal with them, since they can no longer wait for problems to appear and then take corrective action as in the past.

Holt Ashley of MIT predicted that the aeroelastic expert would find himself moving into the mainstream of aeronautical and space technology engineering, and he said that work in aeroelasticity will call for more than

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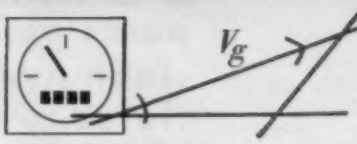

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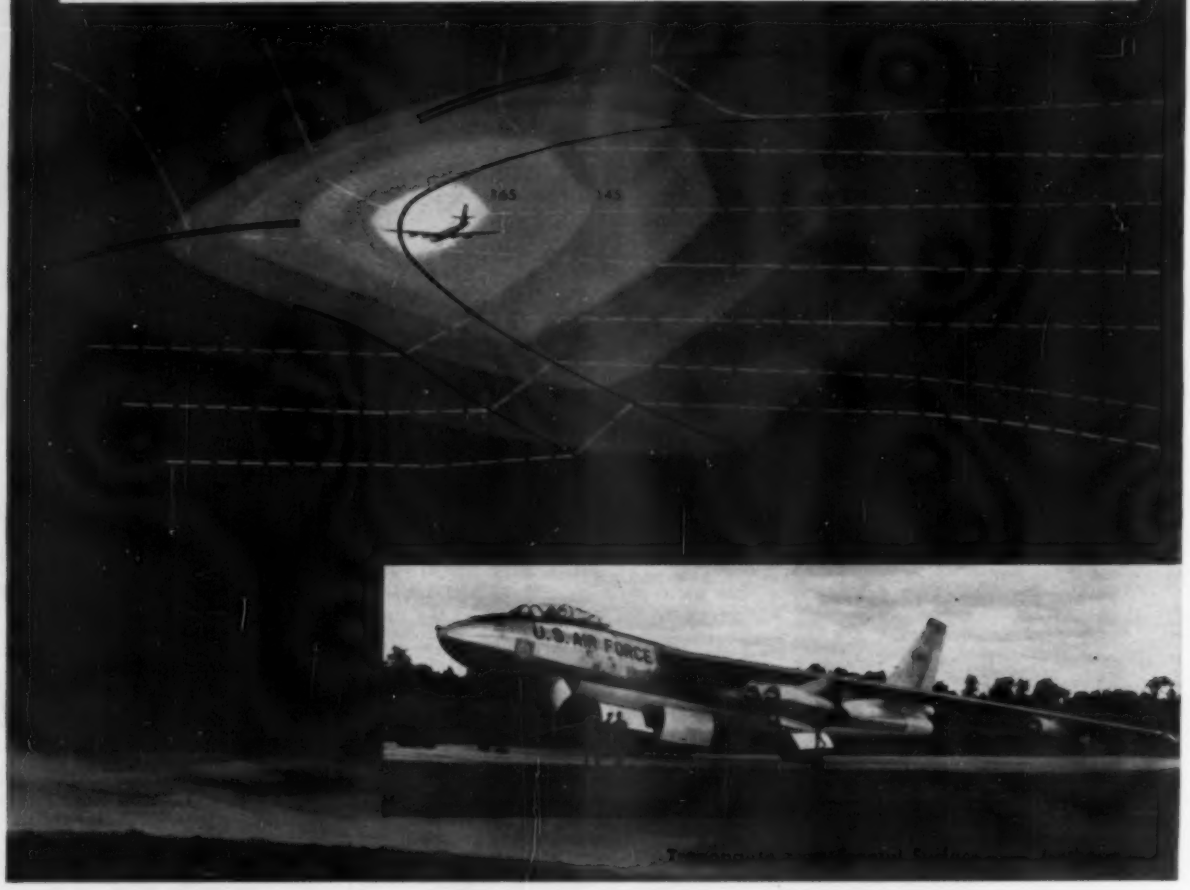

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the ordinary undergraduate engineering education. Ashley observed that the fascination of space is bringing students in droves and that proper education must be provided for them.

Recently developed methods for flutter analysis of wing layouts were also discussed at the IAS meeting. Numerical methods involving the kernel function have been developed at MIT and at National Aeronautics and Space Administration's Langley Research Center, which make use of large digital computers.

A method for flutter analysis of low aspect ratio wings was described by Pao-Tan Hsu of MIT. It is a numerical method for solving an integral equation involving prediction of aerodynamic loads, and Pao-Tan Hsu says it produces improved results over mathematical solutions previously used. He said the MIT method differs from other solutions in that optimum conditions are imposed on the solution.

A somewhat different method for solving the same equation was presented by H. J. Cunningham and D. S. Woolston of NASA Langley Research Center. This method, involving kernel function procedure, produces similar results but reportedly takes somewhat longer to run through the computer program. Both the MIT and NASA developed methods compare favorably with other theories and with experimental results, they reported.

A new method for using a rigid two-dimensional wing model for determining oscillatory pressures at various points on a wing resulting from a pulsating downwash source at a fixed point was described by H. N. Abramson of Southwest Research Institute. Wing model has a blowing and sucking disturbance source at a fixed point, plus a pattern of pressure transducers on its surface. Tests were conducted in a subsonic wind tunnel.

Use of a rigid model would be simpler than the more complex flexible method in experimental work. Abramson said tests showed the rigid model method feasible for subsonic work, and he said that it may apply to supersonic and transonic flow, too. He acknowledged that the method is in an early stage of study, but said that it definitely warrants further development.

Dynamic model tests conducted on the Bell X-2 landing configuration were described by J. N. Deutschman and Monroe Schlessinger of Bell Aircraft Corp. Model tests were performed when initial glide flight tests showed the X-2 had a ground yaw-roll coupling problem.

Results of these tests are understood to have been used in development of the North American X-15 landing gear (AW Oct. 20, p. 26).

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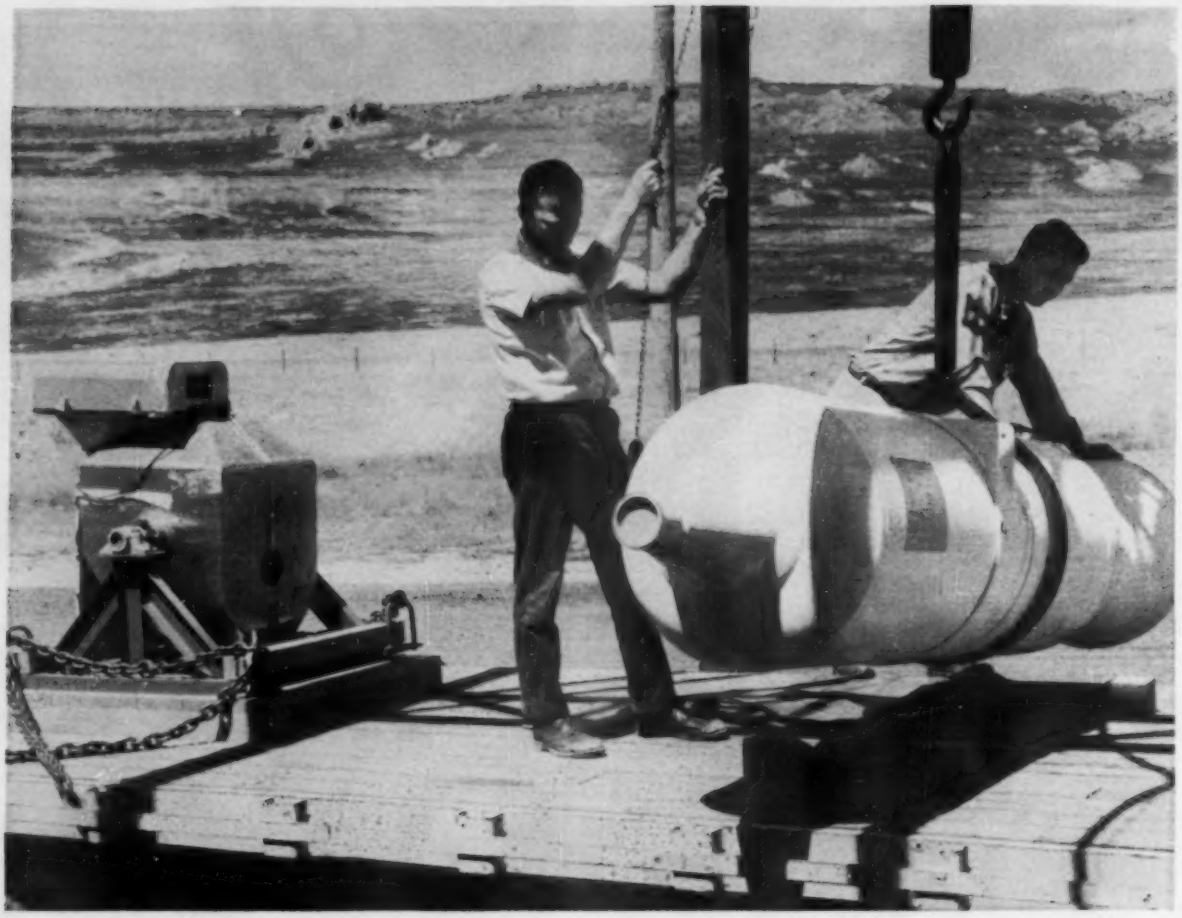

COBALT 60 AND THE MATADOR

Thiokol Chemical Corporation, Utah Division, chose Nuclear Systems' Model 1060 Multitron with a 1,000 curie cobalt 60 source for routine radiography of the Matador engine. The radiographs obtained provide non-destructive testing information which has greatly increased the reliability of the rocket. This unit, along with several others, has been used continuously by Thiokol for the inspection of solid propellants for over a year.

Nuclear Systems offers the most complete line of gamma radiography equipment for this and many other applications.

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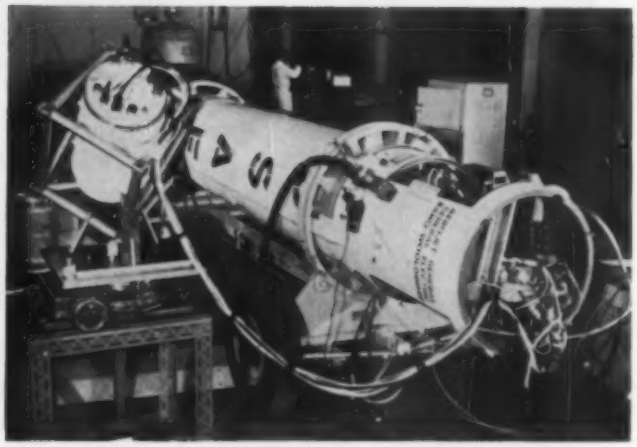
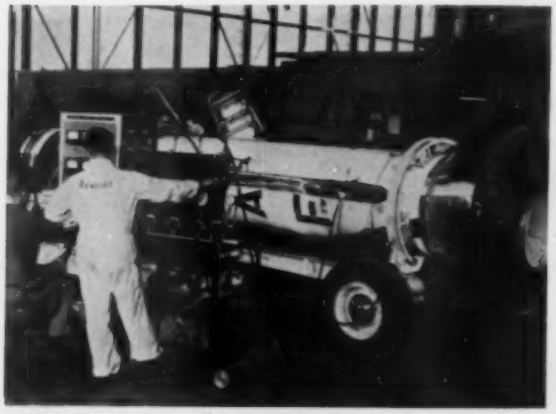
Budd

Aerojet-General Corp. technicians install primer cord on second stage of NASA-USAF lunar probe. Thickness of skin was increased to carry weight of the third and fourth stages, and control section.

Lunar Probe Second Stage Readied for Florida Launching



Lunar probe second stage undergoes tests at Cape Canaveral, Fla. Stage uses hypergolic fuels, requiring no separate ignition system; solid propellant heat generator augments helium pressurization system. Stage weighs more than 4,000 lb. and develops about 7,500 lb. thrust.



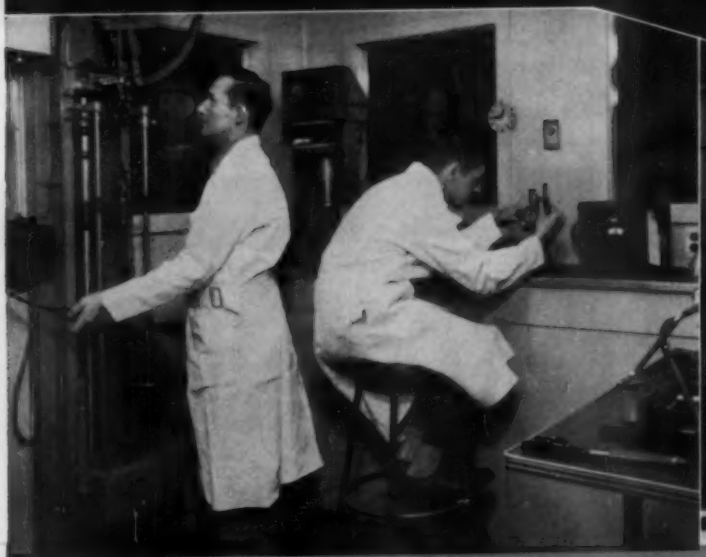
Second stage of lunar probe (above) is checked out by technician. Top end of stage carries control system developed by Space Technology Laboratories, which had over-all charge of technical direction.

Launching vehicle is hoisted into service tower (right) from a trailer. This stage incorporates Aerojet-General AJ-10 engine using unsymmetrical dimethyl hydrazine and white fuming nitric acid.

IN THE FOREFRONT OF JET RETREADS

JET-TRED IS

Successful dynamometer qualification tests in accordance with Tire and Rim Association new tire standards. Simulated 200 mph landings at specified load, roll distance and deceleration.



Continuous laboratory testing measured Jet-Tred for minimum heat build-up; confirmed adhesion to all applicable makes of casings and excellent resistance to heat, tear and abrasion.

On Boeing 707 prototype jet airliner, Jet-Tred proved thoroughly dependable in over a year of continuous service.

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Seven years of engineering, development and testing by Thompson is now culminated by qualification of Jet-Tred* for commercial operations. The qualification test established conclusively that the most stringent requirements set up to measure performance of any tire, new or retreaded, can be met by Jet-Tred. In fact, the expected performance of Jet-Tred indicated by our lengthy test program even exceeds the standards established for the qualification test. Although CAA requirements may vary somewhat from plane to plane, it is now clearly evident that Jet-Tred will meet or exceed the standards for any jet airliner regardless of speeds, weights or specific operating conditions. On that assurance, any airline can, with complete confidence, establish immediate and long-range procurement plans based on using Thompson Jet-Tred. There may be certain technical data you want on weights, inflation pressures, tread wear, number of retreads per casing and other factors on which to base your planning. Thompson will be pleased to advise and work with you directly through a Thompson sales engineer or by correspondence.

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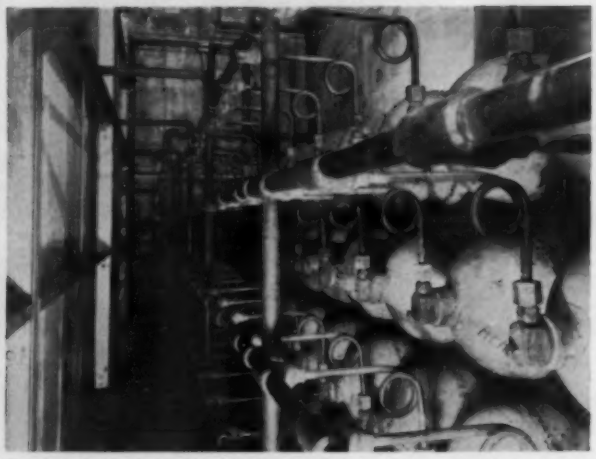

PROPELLANT HAZARD evaluation facility at Navy Air Rocket Test Station, Lake Denmark, N. J., is on hill in background (left photo). Static thrust stands are in foreground. Main test area, in center of photo, consists of variable attitude 100,000 lb. thrust static firing stand, two single solid test cells and two dual liquid engine stands. Nitrogen cascade room (right photo) at Navy Air Rocket Test Station is set up to supply high pressure gas for static firings of large liquid propellant engines on a 350,000 lb. thrust test stand.

Navy Expands Role for Liquid Propellants

By Michael Yaffee

Lake Denmark, N. J.—Contrary to indications, the Navy is not committing itself to solid propellant rockets for shipboard use. Instead, Navy men are now learning to live with and solve the problems of handling liquid propellants aboard ship in preparation for the next generation of Navy missiles and aircraft.

Most likely candidates for liquid engines are air-to-air and air-to-surface missiles, high performance jet fighters (as a supplementary power source) and target drones. More specifically, it is known that liquid engines are under consideration for Chance Vought F8U-3 (AW June 9, p. 21), North American A3J an FJ-4F, and (AW Mar. 10, p. 24, May 26, p. 30), Raytheon Sparrow III and Martin Bullpup. Two other likely prospects are the Eagle (AW Oct. 13, p. 23) and the successor to the Bullpup.

SEVEN Mach diamonds in rocket engine exhaust are an indication of the high performance potential of the liquid propellant engine being static-fired at Navy Air Rocket Test Station.

At present, solid propellants seem to monopolize the Navy's missile arsenal. But for superior performance, liquid propellants are essential.

Solid propellant manufacturers have been talking for some time about matching the specific impulse of liquids. But Cmdr. Robert L. Border, chief engineering officer at the Navy Air Rocket Test Station here, doesn't believe they will catch up with the liquids. Most important, solid propellant grains, despite all efforts to date, remain sensitive to temperature changes, a critical factor, particularly in the performance of air-to-air missiles.

Program Responsibility

To offset these drawbacks, the Navy is turning to liquid propellant rocket engines for a number of missiles now under development. In-service responsibility for this burgeoning program rests largely with the Navy Air Rocket Test Station, located on the site of the old Naval Ammunition Depot at Lake Denmark in northern New Jersey.

Two years ago, the Navy decided to divorce its solid and liquid propellant rocket engine work, giving responsibility for the former to Bureau of Ordnance and for the latter, to Bureau of Aeronautics. BuAer, in turn, has divided its responsibility for rocket work between Naval Air Missile Test Center at Pt. Mugu, Calif., flight test and evaluation, and NARTS, static testing and development.

One of the most important programs now underway here involves prepackaged liquid rocket engines. If liquid

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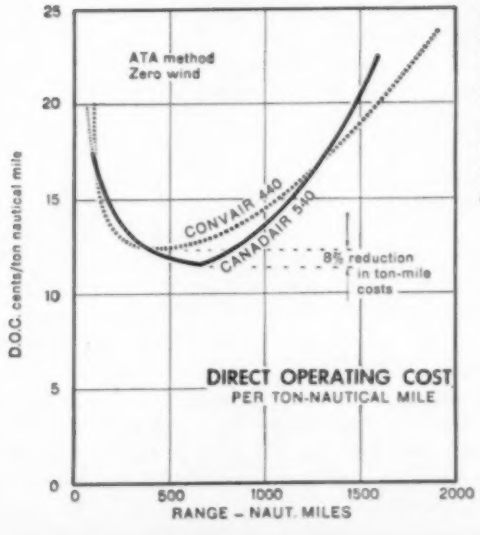
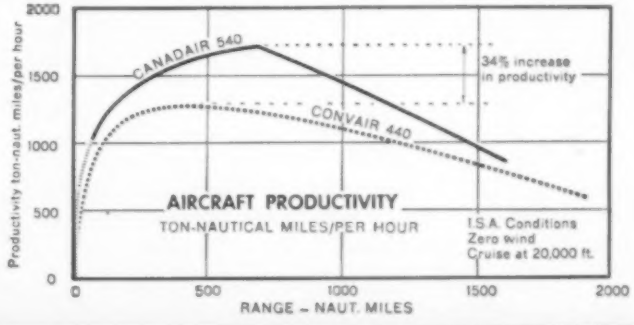


Graph at left, based on the ATA formula, shows that the direct operating costs of the "540" are as much as 8% lower than the "440". This applies particularly on stages over 400 miles; under 400 miles the graph indicates the two are approximately equal. Not reflected, however, are additional reductions in airframe and engine maintenance costs because of the more basic reliability of turbine engines and a minimum of vibration. This makes the "540" more economical than the "440" over any stage length.

Graph below shows the very definite superiority in aircraft productivity of the Canadair "540" over the "440", which is as much as 34% at their optimum ranges. This indicates that for equal annual utilization the "540" could produce 34% more ton miles; or equivalently, the Canadair "540" fleet size required to do the same job could be reduced by 34%, with a consequent saving in capital investment.



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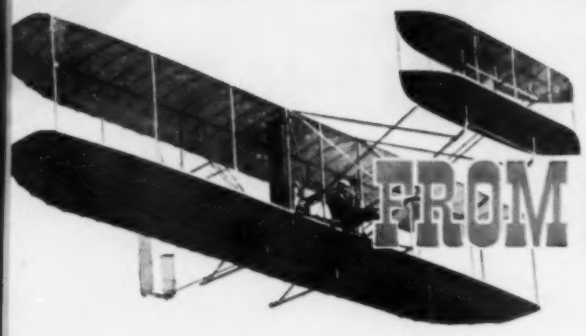
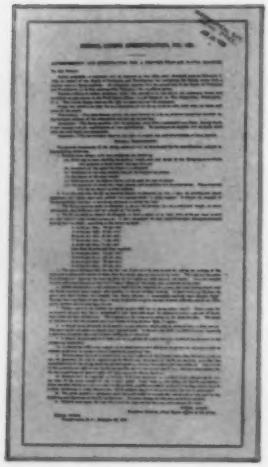


FROM THE WRIGHT FLYER TO

50 Years of U.S. Army Signal



On December 23, 1907, Brigadier General James Allen signed Army Signal Corps Specification No. 486 and made history. It was the first specification by the U.S. Government for "a heavier-than-air flying machine with no gas bag." On February 8, 1908, the Army Signal Corps accepted Wilbur and Orville Wright's bid to provide a machine to meet this "fantastic specification," as it was heralded in the press of that day.

Provisions of the specification included: "2. It is desirable that the flying machine should be designed so that it may be quickly and easily assembled and taken apart and packed for transportation in army wagons...4. The flying machine should be designed to have speed of at least forty miles per hour in still air...8. The starting device must be simple and transportable. It should also land in a field without requiring a specially prepared spot and without damaging its structure... 10. It should be sufficiently simple in its construction and operation to permit an intelligent man to become proficient in its use within a reasonable length of time..."

It was intended that the Wright Flyer be used for military surveillance, but, although it had to meet tough Army standards of reliability, its performance was seriously limited. Carrying a pilot and observer, the old flyer could only be expected to labor dangerously over enemy positions in broad daylight.

TODAY COMBAT SURVEILLANCE DEMANDS DRAMATIC NEW PERFORMANCE WITH NO LESSENING OF RELIABILITY

Now, 50 years later, the Defense and Technical Products Division of Rheem Manufacturing Company has developed the SD-2 Drone to meet the very latest Army Signal Corps specification for a surveillance aircraft. The new Rheem SD-2 is an unmanned, high-performance drone that darts in and out over hostile positions, night or day in all kinds of weather, providing battlefield commanders with an up-to-the-minute picture of enemy activities. Flying ten times faster and a hundred times higher than the early Wright

Flyer, the pilotless SD-2 substitutes electronics and photogrammetry for pilot and observer...but still must face up to the same rugged Army requirements for *field reliability.*

Like the Wright Flyer, the Rheem SD-2 can "be quickly and easily assembled and taken apart and packed for transportation..." (In Army trucks, trains, or Flying Boxcars.) "The starting device" is "simple and transportable." In the field, a standard M-211 truck transports four fully assembled SD-2's, and a zero-length launcher on an M-105A1 trailer provides the completely portable launching device. And, for "landing in a field without requiring a specially prepared spot and without damaging its structure," the SD-2 is provided with a reliable parachute recovery system.

Proving its ability to meet the Army's age-old standard of "simplicity in construction and operation," the Rheem SD-2 is presently being put through its paces at the Army Electronics Proving Ground, Fort Huachuca, Arizona. After passing rigorous Army flight tests, the SD-2 will take its place in the field as another reliable combat system contributing to the superiority of U.S. ground forces everywhere.

If you would like to have a 7" x 12" reproduction of "Signal Corps Specification, No. 486" suitable for framing, write Dept. AW-407-1.

THE RHEEM SD-2 SURVEILLANCE DRONE

Corps Progress in Combat Surveillance

Standard M-211 truck transports four fully assembled SD-2's.

A zero-length launcher on standard M-105A1 trailer provides completely portable launching device.

A simple starter mounted on trailer starts drone engine prior to Jato take-off.

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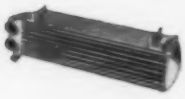

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From General Motors—Temperatures Made to Order! Harrison Cools Engine Oil for New Douglas C-133A Transport!

High-speed, high-capacity hauling is a cinch for this giant of the sky! It's the Air Force's fabulous new flying freighter . . . the Douglas C-133A. Powered by four mighty turboprop engines, the huge Cargomaster ranges 3500 nautical miles with a 40,000-pound load . . . up to 1400 miles with a 95,000-pound load. But heat's no problem with Harrison on the job. Rugged, reliable Harrison oil coolers get first call from Douglas . . . just as they do from many other makers of America's most modern aircraft. They're another product of Harrison's never-ending search to conquer excessive heat under any flying conditions. If you have a temperature control problem, look to Harrison for the answer!

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AIRCRAFT, AUTOMOTIVE, MARINE AND INDUSTRIAL HEAT EXCHANGERS

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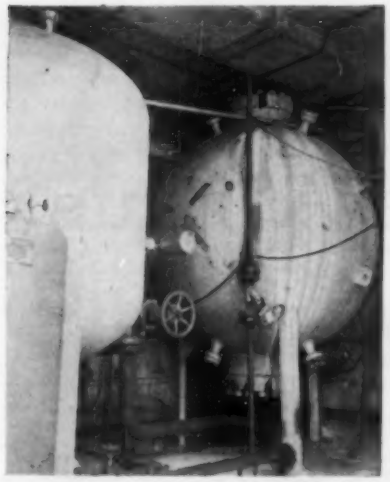
HARRISON RADIATOR DIVISION, GENERAL MOTORS CORPORATION, LOCKPORT, NEW YORK



TANK AND SPHERE (left) provide, respectively, high pressure ammonia and high pressure water for static firings at Navy Air Rocket Test Station. Altitude environment chambers (right) are used by Navy scientists to simulate the low temperatures of the upper air. The chambers are located in a building formerly used for storage of ammunition.

rockets are to replace solids, particularly in air launched missiles, they will have to achieve the same instant readiness as the solids. And, if they are to be used aboard ships, they should require minimum propellant handling and ground support equipment.

At a small sacrifice in specific impulse compared to the higher performance cryogenic-fuel engine, the prepackaged liquid powerplant, fueled at the factory, achieves both objectives while retaining most of the desirable characteristics usually associated with liquid rocket engines.

Attracted by these advantages, Navy BuAer has been actively pushing the development of prepackaged units in conjunction with Reaction Motors Division of Thiokol Chemical Corp. Reaction Motors has developed a family of prepackaged liquid powerplants which it calls the Guardian. Each engine is an integral unit which includes propellant tankage, thrust chamber and all other components necessary for operation.

Guardian I

BuAer has awarded Reaction Motors a contract for the production of Guardian I, a small engine of 8,000-lb. thrust destined to replace the solid propellant unit in the Sparrow III, and a contract for the development of the Guardian II, a slightly larger engine of 10,000-lb. thrust expected to replace the solid propellant motor in the Bullpup.

Until recently, the prepackaged liquid powerplants looked as though they were going to be stopped by a size barrier from moving into the medium and large thrust range. But Reaction Motors disclosed that it had developed and fired a prepackaged powerplant of 50,000-lb. thrust (AW Nov. 10, p. 33). Successful firing of this motor is considered a significant development that theoretically paves the way to prepackaged liquid engines of unlimited size.

NARTS' role in this project is as a field agency and consultant to BuAer. It is running evaluation and qualification tests on the Guardian I, which in Navy parlance is the Sparrow III liquid rocket engine XLR44-RM-2. NARTS will probably do the same on Guardian II, and will write the specifications for all prepackaged liquid engines developed for BuAer.

NARTS scientists are also actively engaged in the research and development of super-performance rocket engines for aircraft and missile applications. In addition, they are screening a number of new monopropellants, fuels and oxidizers. At present, they are particularly interested in high energy fuels and halogen type oxidizers.

Always an important consideration with Navy missiles is the matter of shipboard propellant handling. Currently, NARTS is completing construction of a propellant hazard evaluation facility. Here, Navy hopes to determine first of all the feasibility—i.e., the difficulties and hazards—of handling different fuels and oxidizers aboard ship. Later, it will be used to evaluate the hazards involved in handling full scale missiles or propellant tankage.

Technical Projects

Among the other projects that make up the current technical workload at NARTS are the following:

- **Research and development** on variable thrust liquid rocket engines. NARTS scientists have developed a technique for providing liquid rocket engines with a 20-to-1 throttling capability.
- **Investigation** of new techniques for

EXTREME TEMPERATURE ELASTOMERS

Two New Fuel Resistant Silicone Rubbers

The solution to many present and future seal design problems is imminent with the announcement of two new silicone rubbers . . . Union Carbide's cyanosilicone rubber and General Electric's nitrile silicone rubber. For the purposes of the designer, these materials are the same; namely, *fuel resistant silicone rubber*. Neither is available presently, but we feel they can be safely considered for designs due for delivery early in 1959.

What Are The Properties?

It should be emphasized that these rubbers are an entirely new family of polymers which can be adjusted molecularly to provide varying degrees of fuel resistance. What specific properties they will offer when initially available, we cannot say at this writing. Based on general discussions released by GE and Union Carbide, however, this is what we expect:

Fuel resistance under 300°F equal to that of fluorosilicone rubber.

Above 300°F to 500°F, superior mechanical properties and better fuel resistance than provided by presently available fluorosilicone and fluorocarbon rubbers.

Mechanical properties in the range of presently available general silicone rubbers. Also, a range of durometers.

Extreme low temperature flexibility (−100°F or lower) not now available in any fuel resistant rubber.

No toxic fumes or decomposition products at elevated temperatures.

Raw material cost less than either fluorosilicone rubber or fluorocarbon rubber.

Our own data on these rubbers will be published as soon as we receive and test samples and we will be pleased to send you a copy if you will write requesting same to The Connecticut Hard Rubber Co., 407 East St., New Haven 9, Conn.

CONNECTICUT HARD RUBBER

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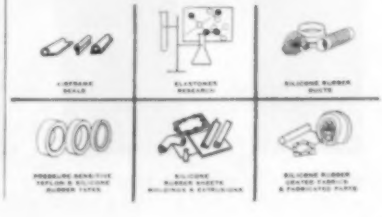

Catching The Airbus?

Turbo-prop comfort at 2d. a mile— and carry your car, sir!

The A.W. 671 Airbus, a variant of the A.W. Argosy freightercoach, will be able to operate over stage lengths of about 200 miles at a direct cost of under 2d. a seat mile. This should greatly ease the economics of operating on ultra-short routes—the routes on which, at present, most operators find it difficult to make any profit at all.

A double decker carrying 126 passengers—30 upstairs 96 down—the Armstrong Whitworth Airbus heralds an era when short-distance air services may run like coaches and trains—regularly every hour.

The Airbus has the same basic fuselage as the A.W. 670 Air Ferry which carries 6 cars on the lower deck and 30 passengers above. Operators whose car ferry traffic is purely seasonal will find it easy to convert Air Ferry to Airbus and vice versa. The spacious hold of this aircraft can, of course, be used for general freighting.

These two variants illustrate the care which Armstrong Whitworth, in planning the A.W. Argosy series, have taken to offer operators maximum flexibility.

Sir W. G. Armstrong Whitworth Aircraft Ltd.
Baginton, Coventry, England
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MAKE THE SHORTEST ROUTES PAY WITH THE A.W. AIRBUS/AIR FERRY

the construction of lightweight rocket engines.

- **Evaluation and qualification** testing of Sidewinder motor and gas generator.
- **Development of a heat transfer** rate analog computer.
- **Consultation** with Fulton Irgon Corp. on a seat ejection device.
- **Investigation** of the detonation of hydrogen peroxide-JP-5 mixtures.
- **Development** of procurement criteria for hydrogen peroxide.
- **Experimentation** in high pressure of engines using hydrogen peroxide-JP-5.
- **Investigation** of ceramic liners for short duration rocket engines.

Officially, NARTS' mission is to "conduct tests and evaluation of rocket engines, their components and propellants."

In reality, the work here ranges widely over the liquid propellant rocket engine field, from comparatively basic research in high energy propellants to the manufacture of a test rocket engine. The station, however, is definitely not a manufacturing center and stops short of making even service prototype engines. Nor does it get into pure research. Unlike the Naval Ordnance Test Station at China Lake, Calif., NARTS has no funds set aside for independent research and so carries out work only on assignment from BuAer or in support of some BuAer program.

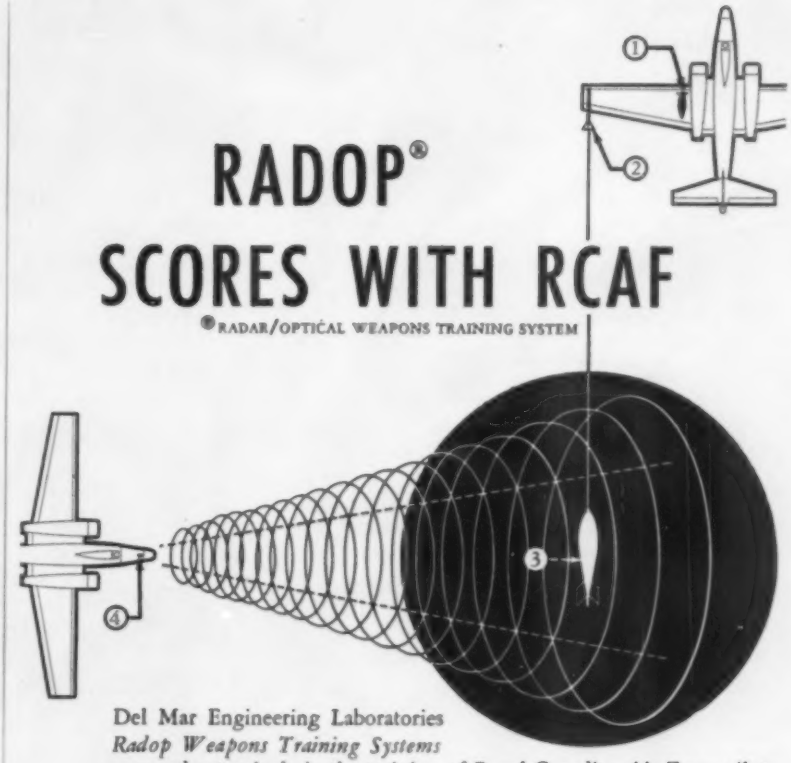
The most important group at NARTS is the Engineering Department which carries out the technical tasks assigned to the station. The other departments serve mainly to support this group.

The Engineering Department, which is under the direction of Cmdr. Border, a graduate engineer, consists of a rocket engine division, a propellant division, an engineer services division and a project group. In addition to Cmdr. Border and another Navy engineering officer, it is staffed by 23 civilian engineers and chemists and about 54 non-professional civilian technicians.

Total number of civilian personnel at NARTS, including Engineering Department employes, is 254. Total military complement is 86.

Commanding officer of the Naval Air Rocket Test Station is Capt. John J. Baronowski.

In addition to the old ammunition storage buildings NARTS inherited from its predecessor, the Naval Ammunition Depot, the physical facilities of the station consist of two dual (4) liquid rocket engine test cells rated at 10,000-lb. trust; two solid engine test cells which upon conversion will be capable of handling liquid rocket engines of 30,000 and 35,000-lb. thrust; 100,000-lb. thrust stand constructed originally to test the 90,000-lb. thrust



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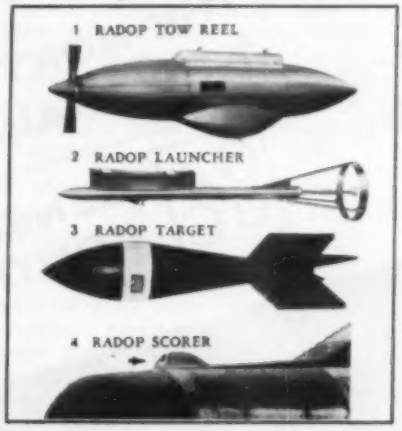
®RADAR/OPTICAL WEAPONS TRAINING SYSTEM

Del Mar Engineering Laboratories
Radop Weapons Training Systems
are used extensively in the training of Royal Canadian Air Force pilots. By firing rockets and missiles at inexpensive Radop Tow Targets and by using Radop Scorers to measure miss-distances in three-dimensions, the RCAF saves Canadian taxpayers millions of dollars and introduces *a higher degree of realism* into training than is possible with other more costly systems.

RADOP SYSTEM COMPONENTS

1. RADOP TOW REEL — First to reel a target out in excess of *seven* miles ...and in less time than required for the tow plane to reach its firing range.

2. RADOP LAUNCHER — First launcher used to eject, tow, and recover targets *in flight*.



3. RADOP TARGET — First lightweight target to contain a special radar reflector capable of being picked up on GCI radars at slant ranges up to 65 miles. Targets also available with flares for missile exercises.

4. RADOP SCORER — First unit to utilize motion picture and radar techniques to provide a positive measurement of miss-distances during rocket firing runs.

For more information on Del Mar Radop Systems, write for Data File AW-538-1.

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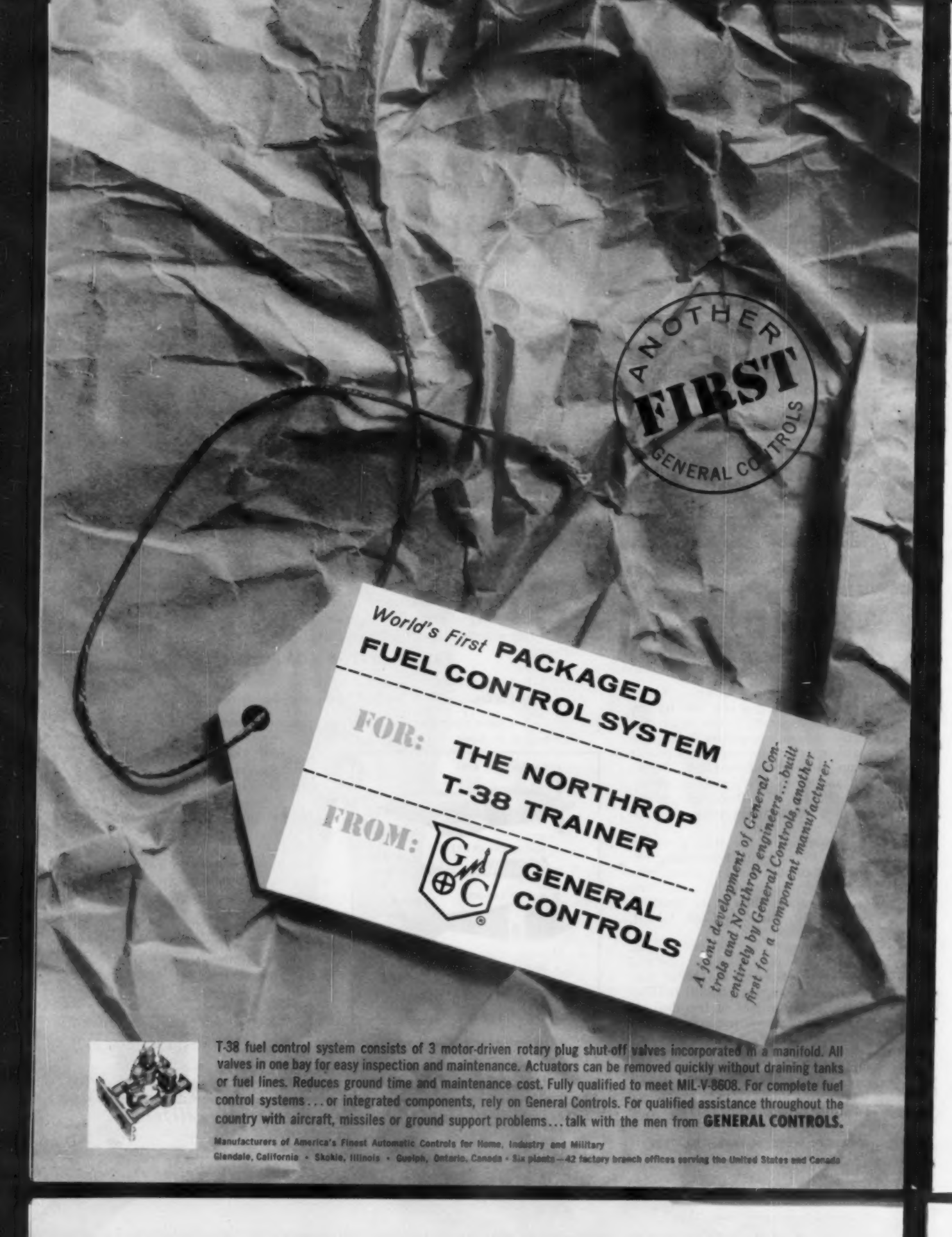

T-38 fuel control system consists of 3 motor-driven rotary plug shut-off valves incorporated in a manifold. All valves in one bay for easy inspection and maintenance. Actuators can be removed quickly without draining tanks or fuel lines. Reduces ground time and maintenance cost. Fully qualified to meet MIL-V-8608. For complete fuel control systems... or integrated components, rely on General Controls. For qualified assistance throughout the country with aircraft, missiles or ground support problems... talk with the men from **GENERAL CONTROLS.**

Manufacturers of America's Finest Automatic Controls for Home, Industry and Military
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booster designed for the Navy's old ramjet Rigel missile.

Conversion of this test stand is scheduled for completion in another six months and will give NARTS the capability for firing regular liquid rocket engines in almost any altitude from horizontal to near vertical. There is also a 350,000 lb. thrust stand for liquid engines that Reaction Motors is now using for its X-15 engine program.

Other NARTS' facilities include a components test laboratory for firing auxiliary power units, the aforementioned propellant hazard evaluation facility, chemical laboratory, altitude environment chambers and a comparatively modern administration office building.

Engineering Department

Station's real property has a replacement value of $16,400,000 and equipment, a replacement value of $2,000,000.

In the next two to three years, NARTS expects to spend about $4 million on improvements for its engineering test facilities. On an average, Cmdr. Border estimates, NARTS spends approximately $78,000-$85,000 a year for equipment. But this figure is expected to increase as the first liquid rocket engines move out of the development program and into operational Navy missiles and aircraft.

NARTS actually signs no contracts. This is done by BuAer. For purchases in support of its own activities, it does have a general equipment fund which it is free to spend on small items. But all major purchases must be funded specifically by the Navy. Construction of large test facilities is handled under the shore station development program. NARTS is presently planning its program for Fiscal 1961 funds.

New Programs

As far as new ideas or programs go, this is also handled by BuAer. Industry may consult with NARTS, but potential contractors must go to BuAer to sell their new missile items and ideas. Similarly, those who are already government contractors may maintain informal liason with NARTS, and vice versa, but again, all formal liaison must take place at the BuAer level.

As NARTS itself views its role in the Navy's growing missile program, it considers its greatest contribution to be as a technical information source and as an advisor to BuAer. Next, in order of importance, would come its propellant hazard investigations, support work it carries out for BuAer contractors, and its research and development on new propellants. The super-performance rocket engine program, which is tied in with its support work, will be very important in the future, says a NARTS' spokesman. But the monopropellant work could actually provide the most important product to come out of NARTS.

Another and somewhat unusual function that NARTS currently fulfills is that of a training center for Navy missile men. Navy assigns personnel to serve in the Engineering Department for the purpose of obtaining experience in the handling, servicing and operation of liquid rocket engines and their components.

This is a function that is sure to grow in importance as the first liquid-powered missiles become operational in the fleet.

Steam Ovens Bake Solid Propellants

Steamheated industrial ovens are employed to bake polysulfide polymer solid propellants at Thiokol Chemical Corp.'s Marshall, Tex., rocket engine facility.

Process involves first spraying a thin coating on the casing and allowing it to cure. Core is then inserted in the rocket casing and the main charge is poured around it. Solid engine is cured in the oven at 100F to 200F to a black rubbery solid. Core is then removed.

Ovens are built by Despatch Oven Co., Minneapolis, Minn.

Is Your Engine Dying In Storage?

Engines lose as much as 50 hours of their potential operating life—while awaiting in storage. Rust, the destructive enemy of polished steel surfaces eats away honed finishes, makes pits, builds up new sources of friction.

In spite of plastic bags, preservation paper and preliminary oil sprays, trapped moisture still causes internal rust. Under normal shop conditions, moisture enters with the air used to spray preservative oil. The moisture proof plastic container traps it as an invisible surface film.

Airwork researched the corrosion problem. No air drying system is 100% safe, so they developed a system of their own. Hot oil (above 220° F.) is sprayed by hydraulic pressure alone. The moisture film on the metal evaporates instantly when the hot oil hits the Airwork overhauled engine. They even designed a special nozzle to make sure the cylinder walls are thoroughly coated. Now, there's no moisture left to start corrosion.

This is one more example of Airwork thoroughness . . . of attention to the small details that make sure you get the best possible service from your engine. In the long run, you always save more with an Airwork overhauled engine.

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Millville, New Jersey

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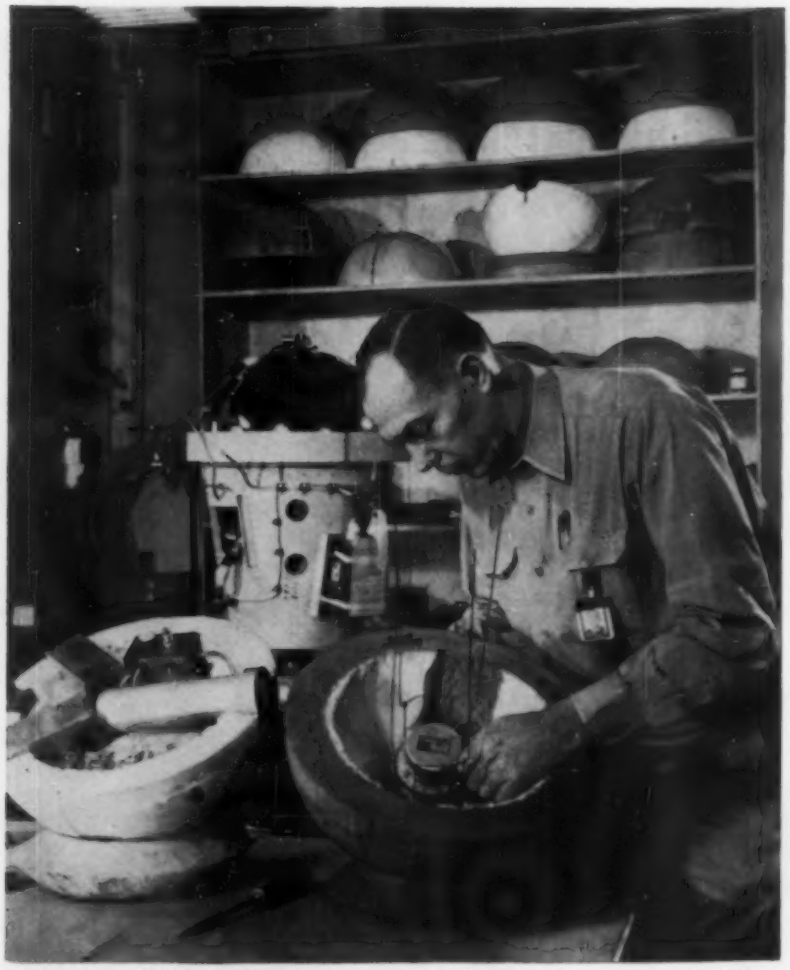

BOTTOM half (left) of missile data recovery capsule houses tape recorder in bottom, battery pack in foreground, junction box in background, dye markers (two boxes at left), and a SOFAR bomb (cylinder in center). Radio beacon is being screwed onto antenna.

Recoverable Data Capsule Designed For Thor and Atlas Test Missiles

Philadelphia, Pa.—U. S. Air Force now can obtain a permanent record of Thor and Atlas intercontinental ballistic missile in-flight data needed for the nose cone development program through use of small, buoyant data-recovery capsules.

Avionic equipment contained in the capsules covers gaps in telemetered information during the missile's re-entry phase, and also ensures against chance radio interference during the flight. Capsules are located in the nose cone and are ejected at a predetermined point prior to cone impact. (AW Nov. 17, p. 37).

The capsule, developed by General Electric Co., carries a small magnetic tape recorder that receives and stores, during its recording periods, all encoded flight data telemetered from the nose cone during flight. The data includes readings on temperature, pressure, stress, acceleration and deceleration.

In addition to guarding against a chance interruption of the usual data telemetering, the capsule obviates the necessity for recovering the nose cone.

The capsule is an 18-in. sphere made of urethane foam plastic and fabricated as two hollow hemispheres. Into what becomes the bottom half goes the tape recorder, a junction box, battery pack, dye marker and a sound fixing and ranging bomb as well (so far) as the connector which feeds information from the nose cone sensors to the tape recorder.

There also is an opening in the bottom hemisphere for exposure of a salt water switch. The top half of the capsult contains a radio beacon, its antenna, and four ground planes for the beacon which are pushed through the

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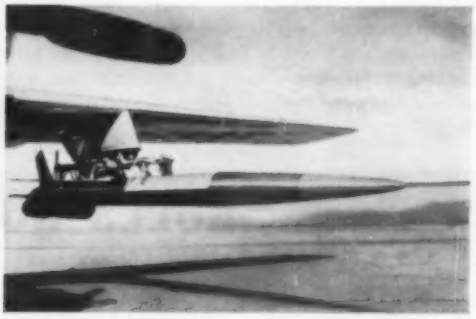
Northrop's supersonic twin-jet N-156F counterair fighter is designed to meet the need of NATO and SEATO nations... a high-performance weapon system that delivers more fighting power at less cost.

NEW NORTHROP FIGHTER BREAKS COST BARRIER!

N-156F WILL DELIVER MACH 2 DEFENSE AT LITTLE MORE THAN HALF THE COST OF FIGHTERS WITH COMPARABLE PERFORMANCE!

RADIOPLANE

Supersonic XQ-4 target: another advancement in a 20-year record of drone design and production for all of the U.S. Armed Forces.



NORTRONICS

Datico gives kill assurance, spares men and man-hours in speeding the vital pre-mission checkout of six proven U.S. missile systems

NORTHROP DIVISION

Supersonic USAF T-38, first of Northrop's new N-156 aircraft family, will train space age airmen at minimum cost; is twin-jet safe.

INTERNATIONAL

The new N-156F counterair fighter, now being built at Hawthorne, Calif., is proof of Northrop Aircraft's ability to create higher quality weapon systems at lower cost. This and other Northrop contributions to national and international defense are products of the Company's cost-minded management team and of Northrop-developed, years-ahead production techniques.

NORTHROP AIRCRAFT, INC.

Beverly Hills, California

ROLLS-ROYCE DEVELOPMENTS

1,000 HOUR INITIAL OVERHAUL LIFE FOR AVON RA.29

The Air Registration Board of Great Britain has approved an initial life of 1,000 hours between overhauls for the Avon RA.29 turbo jet of 10,500 lb. thrust. This follows extensive engine proving flights in de Havilland Comet 2E aircraft, during which engines were examined after lives of 250, 500, 750 and 1,000 hours.

—another technical advance in

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shell for contact with the sea water.

When all the components are in place, the hemispheres are filled with more urethane foam which hardens around the equipment, providing a strong cushion against the 40,000G deceleration force the sphere is subjected to when it hits the water. The hemispheres are then sealed together with additional plastic and encased in a shell of ablative material.

The sphere is then placed in a basket-like container together with a Jet-Assisted Takeoff (JATO) unit and held there with releasable metal straps. The basket is installed in the nose cone with the sphere to the rear.

At the selected time, the JATO unit fires, ejecting the sphere from the nose cone.

The ablative shell shatters upon impact with the water and the buoyant plastic capsule bobs free. Shark repellent is mixed with the dye marker.

In recent tests, according to Maj. Gen Bernard A. Schriever, two Thor capsules, ejected a few thousand feet above the surface of the ocean, have been successfully recovered. One Atlas capsule floated for more than two months until found by fishermen who thought it was a Sputnik. Its magnetic tape, General Electric says, was still intact and in scientifically useful condition.

Certificates of Necessity

The Office of Defense Mobilization has awarded the Newport News Shipbuilding and Dry Dock Co. a certificate of necessity for accelerated tax amortization in the amount of $900,000 with 50% of the amount allowed at the rapid rate. The certificate is for facilities to construct a nuclear-powered aircraft carrier. Other certificates awarded are:

Texas Instruments, Inc., Dallas, development of military electronic devices, $230,000 certified with 40% allowed.

Hamilton Standard Division, United Aircraft Corp., Windsor Locks, Conn., development of rocket engine fuel controls, $83,800 certified with 65% allowed.

Denver Division, The Martin Co., Denver, Colo., research, development and testing of missiles, $252,298 certified with 65% allowed.

Denver Division, The Martin Co., Denver, Colo., research development and testing of missiles, $577,000 certified with 60% allowed.

Denver Division, The Martin Co., Denver, Colo., research, development and testing of missiles, $74,992 certified with 65% allowed.

Hamilton Standard Division, United Aircraft Corp., Windsor Locks, Conn., research, development and manufacture of aircraft parts, $760,690 certified with 65% allowed.

Denver Division, The Martin Co., Denver, Colo., research, development and testing of missiles, $560,000 certified with 60% allowed.

Convair Division (Fort Worth), General Dynamics Corp., Ft. Worth, Tex., research, development and production of military aircraft, $78,692 certified with 65% allowed.

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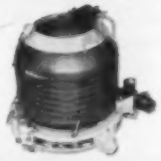

Pioneer in the field of air-borne cryogenic systems, Pioneer-Central offers a complete line of liquid gas converters, valving, and capacitance gaging for artificial atmosphere equipment and compartment cooling and pressurization.

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Finest in breathing regulators—from mask mounted through pressure suit and capsule controllers, global survival kits and emergency equipment to support man in the high performance air vehicle.

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Pioneer vane type fuel flow systems, long the standard of the industry, have now been augmented by new, true mass flow systems of unexcelled accuracy and flexibility as required for jet aircraft and missile applications.

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Pioneer-Central's cryogenic and instrument design and production experience is now being utilized in the production of cryogenic valves, pressure sensing probes and liquid level sensors for advanced missile systems.

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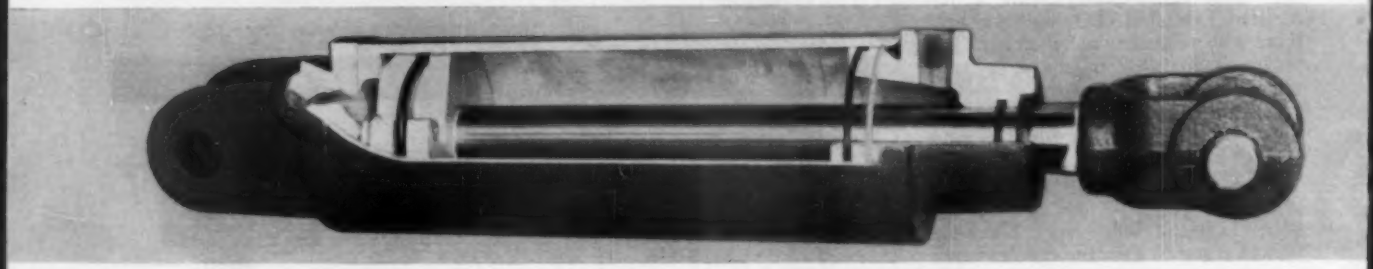
There's a HOLE lot of sense in this use of mechanical tubing

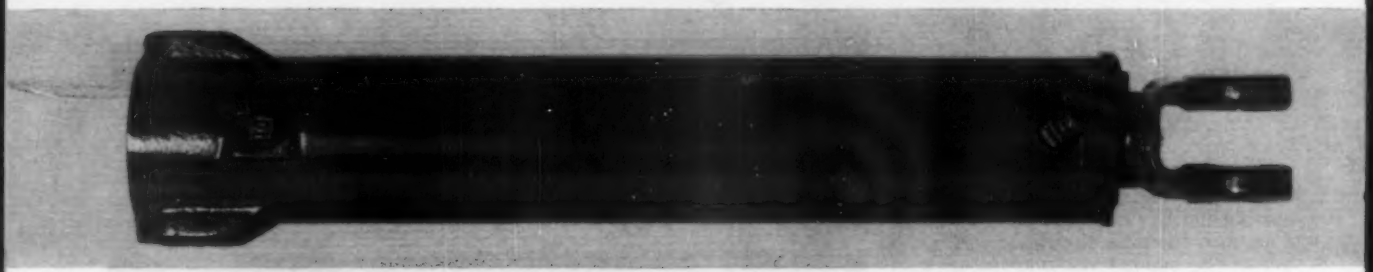
What we're talking about is USS Shelby Seamless Mechanical Tubing. Here's how Industrial Hydraulics Division, Cessna Aircraft Company uses it to boost life, simplify manufacture and lower costs in the hydraulic cylinders they supply to agricultural equipment builders. We quote from their letter to us:

"The cut-away cylinder is a unit we furnish to one of our many customers. This is a 3½" diameter, double-action cylinder used for mounting on pull-behind tools



such as plows, cultivators, and disc harrows. This cylinder uses your Shelby Seamless Mechanical Tubing with the I.D. bored to size and roller burnished to a finish of approximately six to eight RMS. The expected life of this cylinder is in excess of 300,000 cycles, operating at 1,500 psi hydraulic pressure.

"The other cylinder is furnished to another one of our customers, and is a 3¼" I.D. double-action cylinder with a 13" stroke. Used to raise and lower the platform of their self-propelled combine, it is similar to the cut-away cylinder



with respect to finish requirements and material for the barrel. The operating pressure is approximately the same and so is the expected service life of five years, or 300,000 cycles. Generally these cylinders may be serviced for additional use by merely replacing the seals.

"The severe field conditions these cylinders are subjected to are some of the most extreme to which cylinders could be exposed."

In critical mechanical applications like these, and in an almost endless number of fabrications that are essentially tubular in character, Shelby Seamless will ensure improved performance, finer appearance and economical production.

For Shelby Seamless offers more than just a pre-bored hole. It not only combines to an exceptional degree the qualities of strength, uniformity and dimensional accuracy but, in addition, is readily workable and has excellent machining properties. If you want to find out how it can be most effectively applied to your designs, contact your nearby Shelby Distributor.

And remember—USS Shelby Tubing is made by the world's largest and most experienced manufacturer of tubular products.

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AMC Contracts

Wright-Patterson AFB, Ohio—Following is a list of unclassified contracts for $25,000 and over as released by the Air Materiel Command:

Lockheed Aircraft Corp., Burbank, Calif., MB-1 weapons flight test program, F-104A aircraft, (PR PH-1510-7160), $598,997.

Lockheed Aircraft Corp., Burbank, Calif., T-33A aircraft, (PR PH-1510-7176), $728,374.

Boeing Airplane Co., Wichita, Kan., B-52G airplanes, spares, GSE, engineering and technical data, (PR PH-7-01A-7216 and amendment no. 1), $271,412,699.

North American Aviation, Inc., Los Angeles, Calif., F-100F airplanes, spare parts, special tools and ground handling equipment, flight test and data, (PR PH-7-01A-7330 and PH-8-01A-7071), $17,389,040.

Northrop Aircraft, Inc., Hawthorne, Calif., research, development and flight test SM-62 weapons system, (PR XL-1410-7239 and amendments 1 and 2), $18,691,384.

Link Aviation, Inc., Binghamton, N. Y., procurement of B/RB-58A flight simulator, spare parts, GSE, data, services and reports, (PR PH-8-6900-7145), $1,162,948.

Nuclear Products, ERCO, ACF Industries, Inc., Riverdale, Md., F-105D flight simulators, spares, test equipment and data, (PR XF-8-28-7192 and amendment no. 1), $750,000.

Goodyear Aircraft Corp., Akron, Ohio, modification of B-57 aircraft to TM-76A missiles, (PR XM-8-01K-7200), $1,787,360.

Les Jones Training Aids, Inc., Van Nuys, Calif., F-86F cockpit procedure trainer, type MF-6, (PR PH-8-28-7179), $34,447.

Radioplane Division, Northrop Aircraft, Inc., Van Nuys, Calif., OQ-19D aerial target drones (Air Force), OQ-19D aerial target drones (Army), OQ-19B aerial target drones (Army), KD2R-5 aerial target drones (Navy), (MIPR 01-021-58-165, amendments 1 and 2 and 01-021-58-166 and amendment 1, PR PH-8-1550-7164), $6,704,072.

Missile Development Division, North American Aviation, Inc., Downey, Calif., conduct high performance X-10 drone flights to demonstrate weapon capability of the IM-99 (Bomarc), including maintenance, inspection, overhaul and preparation for flight of X-10 vehicles with related ground support equipment, (PR XQ-8-1550-7227), $500,000.

Luria Engineering Co. Division, Luria Steel & Trading Corp., New York, N. Y., allied construction and miscellaneous services to support erection of B-52, C-124 and C-133 aircraft maintenance docks, (PR PM-8-F-5675, PM-8-X-5595, PM-8-X-5242, WL-698451 and WL-693189), $269,396.

Machinery Overhaul Co., Inc., Palmdale, Calif., services: follow-on maintenance and operation of AF DIER storage site No. 2, Palmdale, Calif., for the fiscal year 1959. (PR PB-9-S-9002, 9005, 9005-1), $1,025,796.

American Hydrotherm Corp., Long Island City, N. Y., maintenance and operation of SAGE utilities systems including related services, for the following Air Defense Sectors: Duluth, Minn., and Kansas City, Mo., (PR PM-9-S-6024), $586,947.

The M & T Co., Philadelphia, Pa., maintenance and operation of SAGE utilities systems including related services, for the following Air Defense Sector, Montgomery, Ala., (PR PM-9-S-6025), $283,673.

Pan American World Airways, Inc., New York, group A modification of contractor-owned aircraft for the Civil Reserve Air Fleet program, (PR PM-8-S-5192), $71,064.

Federal Electric Corp., Paramus, N. J., services and supplies necessary to operate and maintain the White Alice Communication System in Alaska, (PR PM-9-S-6028), $17,679,122.

Marquardt Aircraft Co., Van Nuys, Calif., services to accomplish additional testing of RJ43 ramjet engine, (PR PE-7-NPC-4012), $234,611.

Continental Motors Corp., Muskegon, Mich., production engines for the MJ-2 test stands and spares, Packette engines model PE 150-7, (PR MP-8-51A-21082), $492,945.

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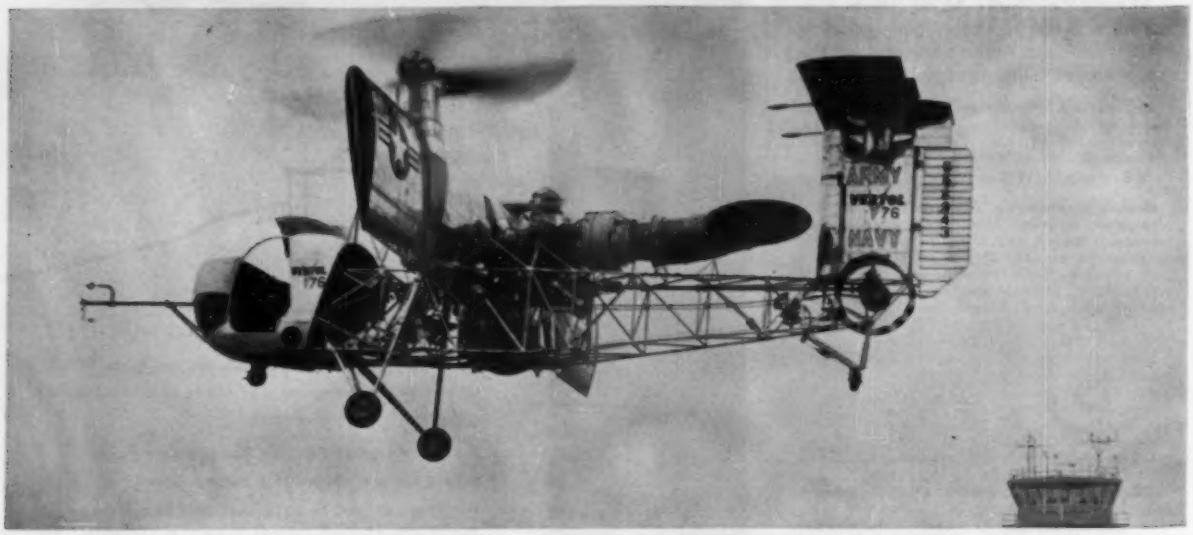


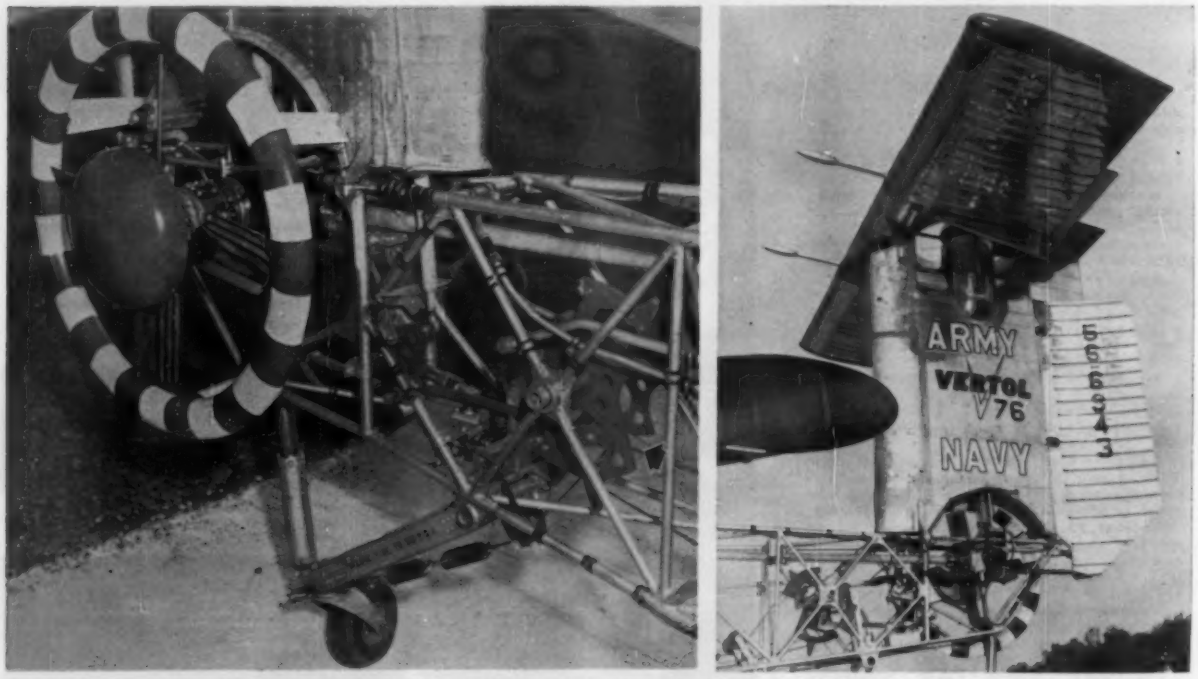
VERTOL 76 VTOL-STOL vehicle hovers with wing tilted at 82-deg. angle of incidence. Powerplant is Lycoming YT53-L-1.

Vertol 76 Control Tested in All Regimes

Turbine-powered Vertol 76 tilt-wing VTOL/STOL research aircraft has successfully completed the basic portion of its study contract and development has progressed to a point where full conversion cycles—from airplane to helicopter to airplane configuration—have become routine operation.

The control system also has been developed to a point where adequate controllability exists in all flight regimes, according to Paul Dancik, Vertol VTOL project engineer.

The contract is sponsored by the U. S. Army and coordinated through the Office of Naval Research (AW July 28, p. 24). The initial phase of the contract having been completed, Vertol is approximately one-third through a follow-on extended flight program to establish controllability, structural integrity and flying qualities of this configuration in a variety of maneuvers not included in the original



YAW FAN on the Vertol 76 is shown in left photo. Arrow points to the control quadrants. The near quadrant controls pitch; the far quadrant controls yaw. Pitch fan on tail (right photo) is mounted in elevator cutout. The yaw fan is on the right side of the fuselage.

Vertol 76 Specifications

Wing span	24 ft. 11 in.
Length	26 ft. 5 in.
Height	10 ft.
Horizontal tail span	9 ft. 11 in.
Rotor diameter	9 ft. 6 in.
Tail fan diameter	2 ft.
Wing area	110 sq. ft.
Wing airfoil	NACA 4415
Gross weight (approximate)	3,200 lb.
Empty weight (approximate)	2,500 lb.

contract. Following this phase, expected to cover some 20 flying hours, the Model 76 test bed is scheduled to be delivered to NASA for evaluation.

The Vertol 76 (Army designation, VZ-2) has accumulated more than 15 flying hours covering extensive hovering tests, six flights in the airplane configuration and 17 complete in-flight conversions. In a recent public demonstration before the American Helicopter Society at Ft. Belvoir, Va., pilot L. J. LaVassar made a conversion from vertical takeoff configuration to approximately 90% airplane configuration in approximately 10 sec. covering 800-900 ft. of runway during a strong right-angle crosswind gusting over the narrow strip. Safety considerations, among them a desire to avoid a deep incline off one side of the runway, prompted the pilot not to attempt full conversion.

To speed the development-to-flight cycle, Vertol engineers utilized existing components as much as possible. The powerplant is a single Lycoming YT53-L-1 normally rated at 825 shp. but derated to deliver 600 rotor horsepower. Rotor speed, in all flight regimes, is 1,400 rpm.

Power transmission to the contra-rotating three-blade rotor-propellers on the tilting wings is by means of mechanical shafting, the rotor-propellers being interconnected mechanically. In event of a power failure, they would override the engine by means of a sprag clutch installed in the upper central transmission, Dancik reports. The only engine controls are a speed selector and power lever, the rotor speed being automatically selected and maintained by a governor in the T53.

Tail Fans

Two fans, for pitch and yaw control, are mounted in the tail. These are four-blade units, both 2 ft. in diameter, each fan consisting of four solid laminated birchwood blades having stainless steel leading edges. Both fans have variable-pitch blades and are interconnected by mechanical shafting. They operate at some 5,800 rpm. Drive is by a smaller lower transmission connected by shafting to the upper

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Ejection seats on military aircraft must function properly . . . every time! That's one reason Stratoflex "Super-T" Teflon Hose is being used on the ballistic release assemblies for the seat ejection mechanisms on Boeing's B-52 intercontinental bomber. "Super-T" hose is fully qualified to specifications of MIL-H-25579. Straight, 45° and 90° fittings are in stock. "Super-T" hose is factory assembled with permanently attached fittings — corrosion resistant, high temperature or extra-lightweight types. Special angles or connections can be made to your specifications. Write for Bulletin S-3 today.

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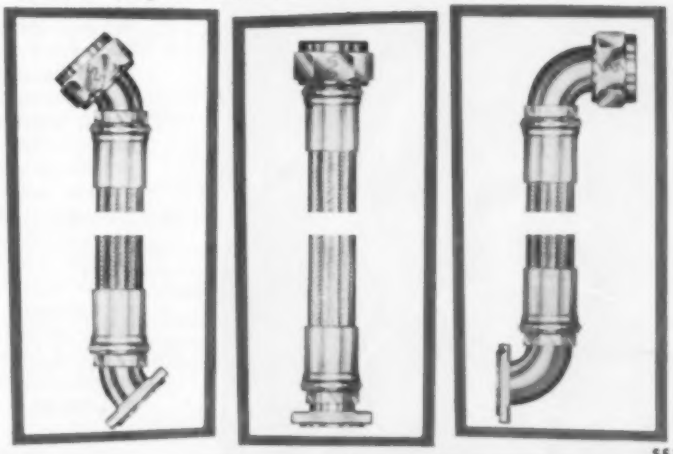

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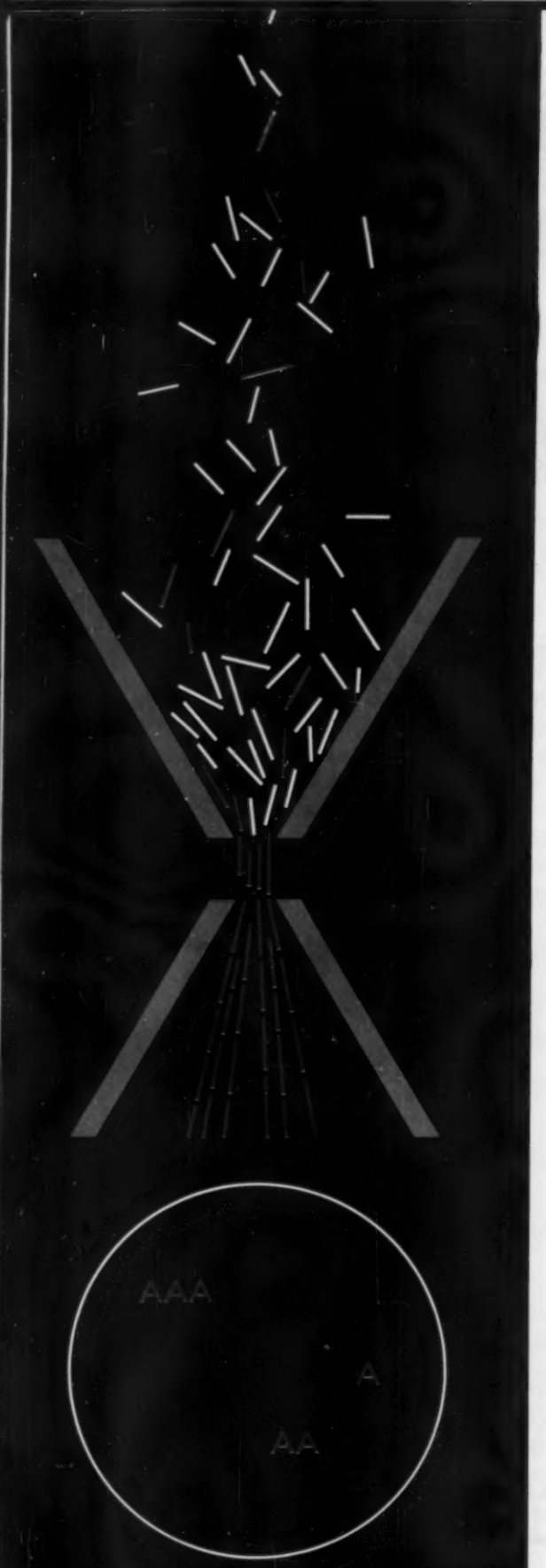

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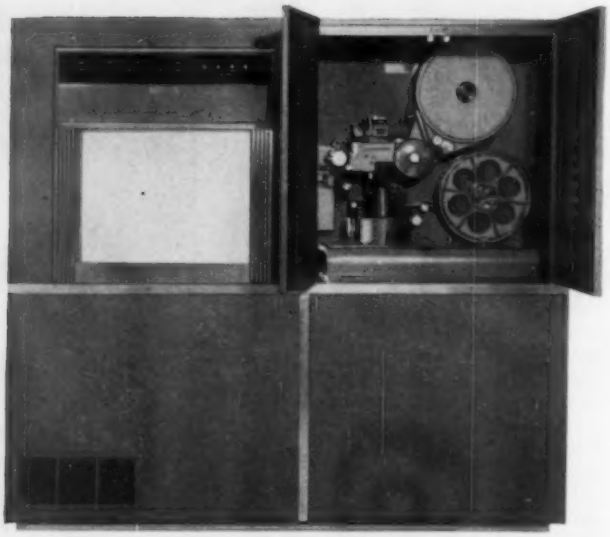

S-C 4000

Series of High-Speed Microfilm Printers

Pictured above is the S-C 4010, one of several High-Speed Microfilm Printers that comprise the S-C 4000 Series. This unit, custom-developed for use with the Naval Ordnance Research Calculator, serves a three-fold purpose: recording data on microfilm at speeds up to 15,000 characters per second, plotting data on microfilm at speeds up to 10,000 points per second, and projecting selected data on a direct-viewing screen less than eight seconds after film exposure.

Two other models in the series are the S-C 4000 — developed for use with the Livermore Automatic Research Computer — and the versatile S-C 4020 — capable of both *on-line* and *off-line* operation and equally adaptable to either business or scientific applications.

Write today for further information concerning the S-C 4000 Series of High-Speed Microfilm Printers . . . outstanding examples of Stromberg-Carlson leadership in the field of readout and display.

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central gear box from the T53. A fluid coupling reduces large cyclic torque experienced early in the test program during rapid control displacements and corresponding changes in power requirements. Analog studies and actual flight tests show that the fluid coupling arrangement for tail fan drive shafts has reduced the amount of dynamic overshoot to less than 5%, Dancik and William B. Peck, chief of stress, special projects, note.

The main rotor propellers are each 8.5 ft. in diameter and are of constant-chord wood construction with stainless steel leading and trailing edges, both steel strips connecting to the bearing housing to help carry centrifugal forces.

An optimum blade twist variation for maximum static thrust has been approximated by a linear twist of 24 deg. from tip to centerline of rotation. Maximum static thrust design was chosen over high cruise efficiency, since performance considerations were of low priority on a test bed type aircraft. Blades are rigid in plane of rotation.

Rotor-propellers are connected to the powerplant by means of drive shafts to right angle gear boxes mounted in each nacelle, the shafts passing from the upper central gear box mounted at the T53's power output end through the fuselage hinge points.

Pilot Controls

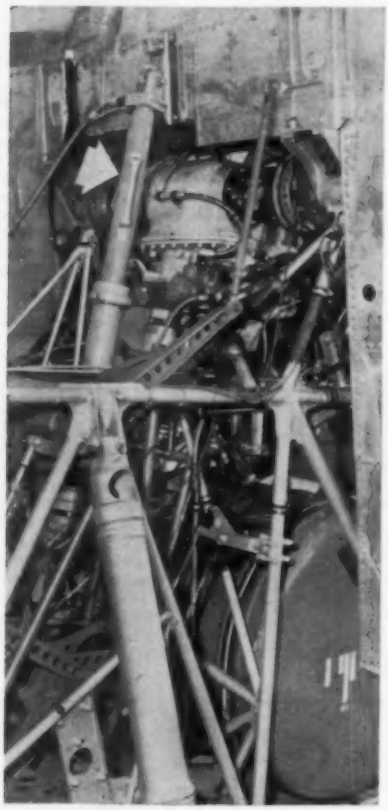
Pilot's controls consist of pedals, control stick and collective pitch lever. Atop the control stick is variable-speed wing-tilt switch to actuate the hydraulic servo cylinder which operates the wing. Pressure is derived from a pump on the central transmission gear box. The wing is fixed to the fuselage by two self-aligning bearings.

Hydraulic system is of the 1,500 psi. type.

In hover flight, control is achieved as follows:

• **Vertical ascent or descent** is accomplished by varying simultaneously and equally the collective pitch of each rotor-propeller by means of the collective pitch lever.

• **Roll control** is by means of differential collective pitch in the main



WING center section of Vertol 76 is shown in vertical takeoff position. Aircraft's cockpit is toward left; tail is toward right. Arrow points to the hydraulic actuator for wing tilt. The clip on this actuator is in place when the aircraft is inactive to prevent inadvertent full forward wing tilt. The T-shaped upper central transmission (behind wing tilt actuator) bolted to forward end of Lycoming YT53-L-1 power-plant transfers power to left and right rotor-propeller gear boxes and also transfers power to lower transmission which transmits power to tail fans.

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Delivers any selected response from 1 to 10 seconds in ducts with 1" to 4" opening, pressure to 300 psi, and temperatures of −65°F to 1000°F. Impedance level of less than 500 ohms eliminates terminal problems. Fast, accurate operation—no relays or limit switches required.

Detailed Data for Those Who Design for Flight

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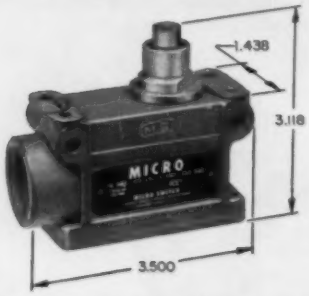
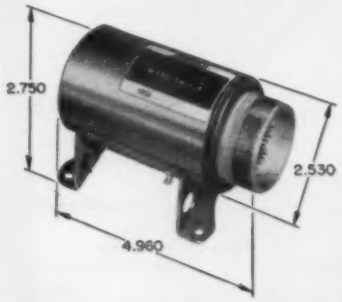
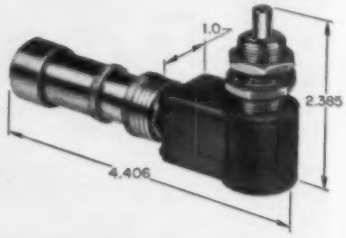


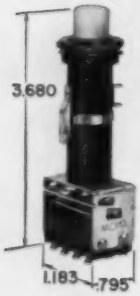
4CE1—This weather-proof, corrosion-resistant switch is used as an indicator or limit switch on missile shelter, erecting and launching equipment. Has SPDT contact arrangement. Rating: 10a. 125vac; 5a. 250 vac. Operating force 6-10 lbs. *Data sheet 151.*



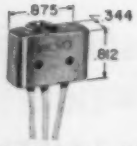
1RS1—High reliability telemetering switch for missile program sequencing. Hermetically sealed. Has rotary solenoid and 24 SPDT gold-contact "SM" switches. 74 terminals. Quick disconnect plug. *Data sheet 151.*



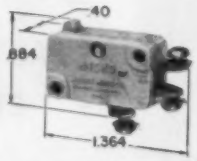
1EN42-R—A special design for high shock applications. Used on shipboard launching equipment. Meets requirements of U. S. Navy Bureau of Ordnance. Contains two SPDT switches. Quick disconnect connector. Ice and mud scraper on plunger. Operating force 6-12 lbs. Rating at 28vdc: inrush 24a., resistive 4a., inductive 3a., motor 4a. *Data sheet 151.*



54PB67-T2—Space-saving lighted pushbutton assembly. Flexible indication provided by indicator lamp and two-level position of button. Alternate action (on-off) of the switch contacts is provided. Four SPDT subminiature switches. All switch and lamp terminals are isolated. *Data sheet 133.*



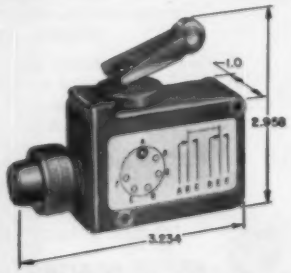
1SE1—Smallest sealed environment-free switch. SPDT. Rating at 28vdc: ind. 3a., res. 4a., inrush 15a. Leaf and roller-leaf auxiliary actuators available. *Catalog 77.*



V3-1301—Operates reliably at 600°F. For jets, missiles, electronic gear. SPDT. 30vdc rating: ind. 10a., res. 10a., motor 6a. *Cat. 74.*

12HR1-S
Hermetically sealed, high temperature DPDT switch for reliable use to 600°F. All seals in accordance with Par. 5.2.2, MIL-E-5272A. Ice scraper ring on actuator. Rating: 28vdc—res. 5a.; ind. 2a. Operating force 6-12 lbs. *Data sheet 122.*

44EN1-6 (MS-24420-4)—Rotary actuator adjustable through 360°. One 4-circuit basic switch. Rating: 28vdc-inrush 30a.; res. 15a.; ind. 10a. Operating torque—10 in. lbs. *Catalog 77.*



3EP2-E—Sealed enclosure. Rugged, two-hole side mounting. Two high capacity SPDT basic switches. Sealed connector receptacle and roller lever actuator. Rating: 28vdc—inrush 36a.; res. 10a.; ind. 6a. Operating force 4-6 lbs. *Catalog 77.*

201LS1—Heavy duty, sealed "Plug-in Limit" switch. Can be replaced on the job in 20 seconds. Switch enclosure, with actuator, positioned by dowels and secured by two No. 10 screws. Available in six actuator designs. Used in ground equipment as limit or indicator switch. *Catalog 84.*

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Each of the switches illustrated on these pages represents a different *series* of MICRO SWITCH Precision Switches . . . Each switch has been designed to high reliability standards for a particular purpose . . . Each series includes many variations—sizes, weights, contact arrangements, electrical characteristics, housings, actuators, sealing, temperature, shock and mechanical characteristics . . . For example, the switches in which "EN" is a part of the catalog listing constitute a series in which nearly 100 different switches and assemblies are available . . . No other source of precision switches offers as broad a line . . . Furthermore, no other can offer the services of as large a staff of Application Engineers—in branch offices at strategic points throughout the country. Consult the yellow pages.

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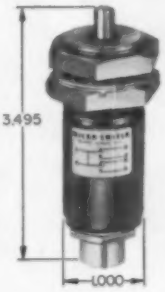
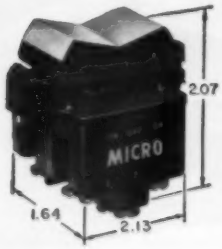


1EN75-R—High-impact shock switch for use on launching platforms, near jet after-burners, etc. Heavy duty push plunger with ice-mud scraper. Operating force 6-12 lbs., release force 4 lbs. Environment and immersion proof (MIL-S-901B, Navy and MIL-E-5272A, Proc. 1). Contains two SPDT switches. Available with straight (shown) or angle connector plug. *Data sheet 152.*

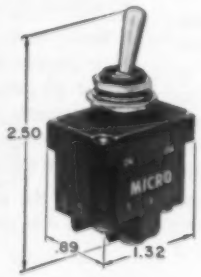
5ET1-6—Compact, magnetically-held toggle switch has a built-in 28vdc solenoid. Works as a momentary action toggle switch, but is converted to a maintained contact switch when solenoid is energized. Permits remote electrical release of the lever, thus eliminating auxiliary relays, etc. Toggle lever can be manually over-ridden. Environment and immersion-proof enclosure (MIL-E-5272A Proc.1). SPDT basic switch. 28vdc. rating: inrush 24a., resistive 4a., inductive 3a., motor 4a. *Data sheet 121.*



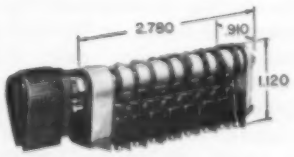
4TP1-1—Rocker-actuated key switch combines the advantages of both pushbutton and toggle manual control. Key is flat, like a pushbutton and can be engraved, but has toggle feature of visible position. Also enhances panel design and provides edge-light indication. Construction of case is rugged and sealed, with integral, stepped terminal design. 4-pole DT circuitry (others available). 28vdc rating: res. 20a., lamp 7a., ind. 15a. *Data sheet 141.*

4TL1-1A—Same features as 2TL1-1 except toggle lever has safety feature which requires pull to unlock and move the lever. (Available in a variety of locking arrangements.) Knob facilitates operation with gloves. 4-pole DT circuitry. Rating same as 2TL1-1. *Data sheet 142.*

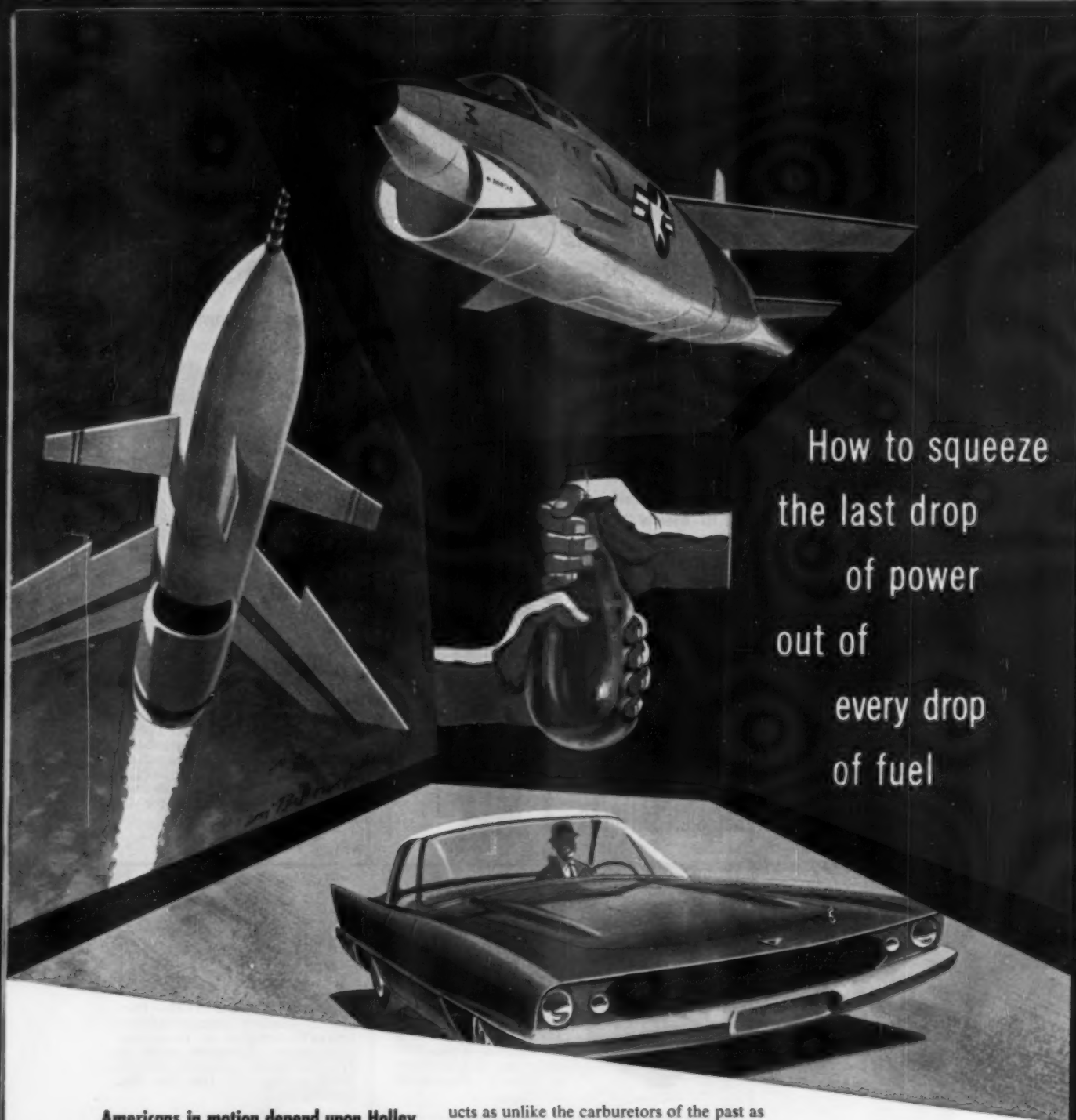
1HS1 (MS-25011-1)—Hermetic sealed construction (metal-to-metal or metal-to-glass seals). Contacts sealed in dry gas under pressure. SPDT. 28vdc rating: ind. 10a., res. 25a. *Catalog 77.*



2TL1-1—Integral, stepped terminal design. High impact strength, arc resistant case. Silicone seal on bushing and self-sealing sealant between cover and case. 2-pole DT circuitry. Rating at 28 vdc: res. 20a., lamp 7a., ind. 15a. Available in variety of toggle positions. *Data sheet 139.*



17AS8—Compact rotary selector switch handles eight different circuits, requires only 1¼ inch diameter panel area. Switching sequence is infinitely variable. *Data sheet 86.*



Americans in motion depend upon Holley

The startling advances in the last decade in pounds of thrust, in horsepower have exceeded nearly every other decade in America's engine development history. The challenge of contributing to this advance has fallen to Holley engineering teams with such varied problems as lighter weight, more compact fuel controls for jet engines, carburetors with more and more breathing capacity, ignition systems with more and more accuracy.

Holley's two teams of design and manufacturing engineers have developed products as unlike the carburetors of the past as jet engines to Stanley steamers.

Today, Americans stand on the threshold of a decade which will far outmode the power outputs of today. Holley engineers are currently working on control systems for power outputs relegated just yesterday to science fiction.

As in the last fifty years, Americans in motion will depend upon Holley products.

For more information about Holley products, automotive and aircraft, write to HOLLEY CARBURETOR CO., 11955 E. Nine Mile Road, Warren, Michigan.

6-2

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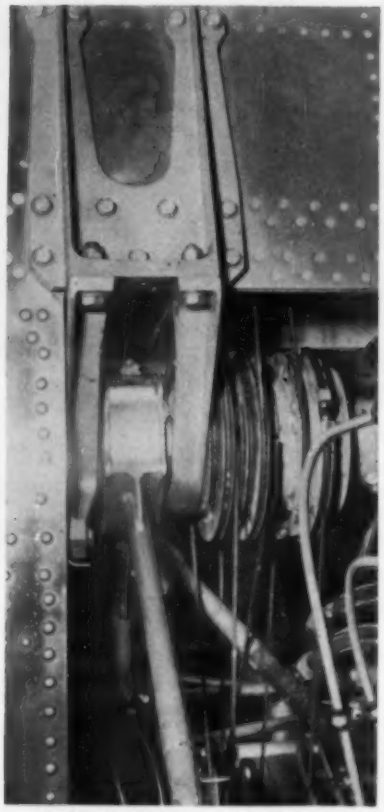

WING PIVOT POINT is shown here. Machined 14ST aluminum fittings (upper left) take wing rotation loads. Cables control pitch, differential collective and ailerons.

rotor-propellers using lateral motions of the control stick.

• **Pitch control** is achieved by varying blade angle of the pitch fan inset in the horizontal tail.

• **Directional control** is by varying the blade angle of the yaw fan, mounted vertically on the right side of the tail, by means of foot pedals.

Pitch and yaw fans are connected in parallel with elevator and rudder respectively. Fans operate in all flight regimes, the vertical and horizontal movable control surfaces becoming effective as forward speed increases.

Control During Conversion

During conversion from hover to airplane flight, the lateral control system automatically changes to airplane controls, differential collective pitch system phases out and the conventional aileron system (which operates in reverse during hover) simultaneously reorients itself and phases in. With wing full down, in airplane configuration, roll control is achieved through the ailerons alone.

Collective pitch lever is not affected by wing tilt position and is used as a propeller pitch change lever during

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Litton Industries offers research appointments of the highest order of importance to the nation's defense and economic endeavors. Applicants must have proven capability at the professional level for contributions toward the advancement of knowledge in the fields of computation, guidance, communication, or control.

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These few men will have as their resources the skills of any of a thousand people who are the life of the electronic complex which is the Electronic Equipments Division of Litton Industries. They will command the most advanced computational instruments as their tools, plus the only Inhabited Space Chamber in the free world, plus engineering and manufacturing facilities which produce complete systems.

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Vertol 76 (VZ-2) History

April 15, 1956—Vertol received contract, sponsored by U. S. Army and coordinated through Office of Naval Research, to design, build and test a tilt-wing VTOL research vehicle.

Aug. 13, 1957—V-76 makes first hover flight.

Jan. 7, 1958—First flight in airplane configuration.

June 6, 1958—V-76 start build-up toward first full conversion.

July 15, 1958—First full conversion in flight.

flight. With engine speed held constant by the engine governor, the collective pitch lever converts to the throttle in forward flight.

Wing tilt arc covers angle from 82 deg. when in full vertical takeoff or landing position to 9 deg. when Model 76 is in full airplane configuration.

Flight test development has resulted in a vehicle that can be controlled in any configuration without automatic stabilization systems in winds up to 20 kt., Dancik and Peck report. Conversions have been made with the damper systems turned off. Stability and roll augmentation are provided in the form of pitch and roll rate damping.

Altitude control can be maintained without effort and stick trim positions are not excessive during the conversion cycle, the Vertol engineers note.

Taxi runs can be made at reasonable speeds with wing incidence angles as high as 60 deg.; at wing positions above 45 deg., dirt can be blown into the cockpit. Pilot has developed a technique for fast deceleration on the ground consisting of reducing the main pitch control to the minimum setting in the airplane configuration and then tilting the wing up to act as a drag brake.

Germans to Produce Rolls-Royce Turbojets

Bonn—M. A. N. Turbomotoren GmbH., a subsidiary of the mechanical engineering company Maschinenfabrik Augsburg-Nuernberg, will develop and produce Rolls-Royce jet aircraft engines under license.

The subsidiary is raising its basic capital from $1,230 to $123,000 and moving its headquarters to Munich. Initial production is envisaged for the domestic market. Contacts with German aircraft firms have already been initiated.

Most likely candidate for a new M. A. N. Rolls-Royce powerplant would be a proposed 40-ton turboprop transport for the German air force. Three German designs for such a transport have been submitted to a joint French-

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For more information please write to: Mr. A. L. Stevenson, Engineering Personnel, North American Aviation, Inc., Los Angeles 45, California.

THE LOS ANGELES DIVISION OF
NORTH AMERICAN AVIATION, INC.

Avionic Capability Improved in Latest A4D

Navy Douglas A4D-2N Skyhawk night attack aircraft has same airframe configuration as A4D-1 and A4D-2, except that aircraft is about 1 ft. longer (AW Nov. 17, p. 37). The A4D-2N is equipped with improved weather and navigation capabilities and is designed for pressure and in-flight refueling. Douglas has $79 million contract for A4D-2Ns.

Italian-German armaments team, which is expected to reach a decision in December. Forerunner reportedly is a proposal by Hamburger Flugzeugbau, one of a consortium of North German aircraft companies presently building the French Noratlas under license.

Bell Tests 47-J For Noise Level

Ft. Worth—Noise studies conducted by Bell Helicopter Corp. indicate that the Model 47 helicopter is quieter than trains, trucks and aircraft at the noise levels generated by these vehicles in public areas.

Comparing various sound measurements, Bell engineers found that the 47-J operating within 200 ft. of a city street is no more disturbing than an automobile horn 20 ft. away or a truck starting up 50 ft. away. Other comparisons showed the 47-J at 300 ft. to be quieter than a train at 100 ft., a truck moving on the highway at 20 ft. or a four-engine aircraft takeoff at 500 ft.

Bell notes that despite these findings, the helicopter is still considered noisy in some quarters. This is ascribed to the novelty of the machine in city areas and the fact that it makes different types of sound than those normally heard in a downtown area. Company said that as soon as the novelty of intra-city helicopter operations wears off, the 47-J won't attract any more attention than other forms of transportation.

SC.1 Tested for Scorching Effect on Ground

Short Brothers & Harland Ltd.'s SC.1 VTOL makes a vertical landing on grass to determine what effect jet blast from the four downward-pointing Rolls-Royce RB.108 axial-flow engines would have on the turf. Only effect was slight scorching of grass beneath engine bay.

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CEC's compact airborne

DataTape *system*

cuts space requirements in half

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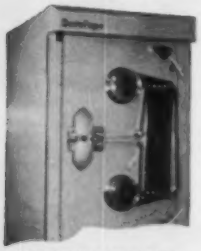
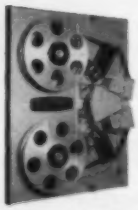
5-702 RECORDER



ADJUSTABLE TAPE LOOP ATTACHMENT FOR 5-752 RECORDER/REPRODUCER

5-781 MAGNETIC-TAPE RECORDER/REPRODUCER (CONTINUOUS LOOP)



DIGITAL MAGNETIC-TAPE RECORDER/REPRODUCER

HIGH-TEMPERATURE/HIGH-ALTITUDE OPERATION

Here's the smallest package in magnetic tape instrumentation: CEC's new Airborne DataTape System. Designed for precision performance in *test flights up to 100,000 feet in ambient temperatures from −50° to +100°C* ...easy to install in heavily instrumented aircraft because of its small size and low weight.

HIGH-STRENGTH CASE

The all-new 5-702 DataTape Recorder is enclosed in a rugged, lightweight case of cast magnesium alloy that is precision machined to assure accurate alignment of internal components. Infinitely superior to sheet-metal cases that bend and yield to stress.

FLEXIBILITY IN USE

The highly flexible 5-702 provides 7- or 14-track operation with *exclusive front-panel switch selection of all six tape speeds* from 1⅞ to 60 ips, using 10½" standard NARTB reels or special CEC high-performance reels of ½" or 1" tape.

A single cast aluminum alloy case houses seven miniaturized record amplifiers. The system converts readily to 14-track operation by simply adding a second 7-amplifier case and changing tape width.

DOWNSTREAM MONITORING

Use of all-metal-surface playback heads permits simultaneous downstream monitoring of all tape tracks—continuously and virtually coincident with the recording of test data. These reproduce headstacks also allow the 5-702 to be used as a laboratory playback machine.

The new airborne system provides FM, PDM or Analog recording through its interchangeable plug-in amplifiers, and is completely compatible with CEC's 5-752 Recorder/Reproducer.

For complete details, contact your nearest CEC sales and service office or write for Bulletin CEC 1607-X6.

TYPE 11-114 AIRBORNE REMOTE CONTROL INSTRUMENT-PANEL UNIT

Allows remote operation of the 5-702; indicates per cent of tape remaining on supply reel. Requires standard 3⅛" aircraft-panel opening for mounting.

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Rivalry Intense in Soviet Weapon Design

By J. S. Butz, Jr.

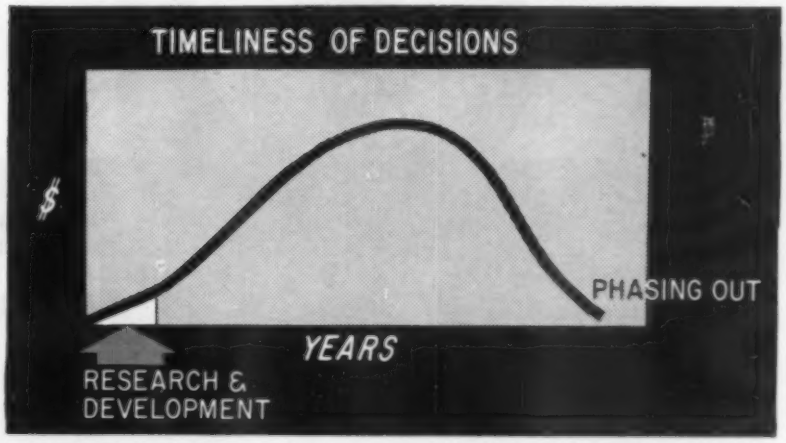
(This is the second of two articles describing the Soviet management structure for weapon system developments.)

Washington—Soviet weapon development is characterized by intense competition and the promise of large financial reward for individual achievement, two features seldom absent in any period of rapid industrial growth.

Final competition between military aircraft designs in Russia is not held on paper.

In the development of an operational aerial weapon system, the Soviets generally carry two or more designs to the full-scale flight test stage where hand-built experimental aircraft are flown in direct competition.

The selection of production aircraft is not made until after a flight test comparison.



RELATIVE costs of procurement and research and development phases of weapon development is shown in graph by Paul D. Foote, Assistant Secretary of Defense (Research and Engineering). Decision to drop least promising projects after research and development is completed, can save money and allows many ideas to be pursued at lowered cost. This approach is used by the Soviets in aircraft development before selecting production models.

Financial Record

Financial reward is available to any Russian design group that does what it said it could do. Even the designers who lose a flight test competition receive a bonus if their aircraft achieves the performance that they had originally promised.

Soviet technical literature is increasingly revealing in detailing the structure of the Russians' weapon development management. And Dr. J. Sterling Livingston of the Harvard Business School, an accomplished student of the Soviet Union, has testified at length to congressional committees on the subject of Russian military management.

His testimony within the last year has included the following pertinent statements:

"When they (the Soviets) undertake the development of a weapon system, typically they have three or four—sometimes only two—but typically three or four different designs undertaken simultaneously. They have a very strong competitive system in the design of their weapons.

Selection on Merit Alone

". . . There is another important factor in the Soviet system which varies from our system. When the Soviets reach the prototype testing stage, they select their weapon solely on the basis of its merits."

In another portion of his testimony, Dr. Livingston quoted Maj. Gen. John B. Medaris, commander of the U.S. Army Ordnance Missile Command, who said: "Some place there has to be one man who can make a decision, who can give a command and who has the resources to carry it out." Dr. Livingston then commented:

"I certainly agree with that, and I think we should keep in mind that the Soviets have used this method admirably. They have developed a keen sense for fixing responsibility; they provide great incentives for success, and they provide very substantial penalties for failure."

The technical freedom and personal authority that Soviet designers have in their competition with each other also was described by Dr. Livingston. "In

Increase in Lead Time Due to 'Concurrences'

Steps	Time for preparation* Months	Time for concurrence* Months
1. Development planning objectives:		
(a) Actual preparation	3	.....
(b) Obtaining concurrences	.....	12
2. General operational requirements:		
(a) Actual preparation	3	.....
(b) Obtaining concurrences	.....	6
3. Development plan:		
(a) Actual preparation	14	.....
(b) Obtaining concurrences	.....	4
4. Development directive:		
(a) Actual preparation and selection of the contractor	4	.....
(b) Obtaining concurrences	.....	3

* Col. William F. Scott, USAF (master's thesis).

DIVISION of authority over U.S. weapon development projects has created procedure of "obtaining concurrencies" from the many people who participate in making decisions. As shown here, in a study by USAF Col. William F. Scott, this procedure takes approximately the same time as that required in actually performing planning work. The Robertson Report, compiled for Department of Defense under direction of Ruben Robertson, former Deputy Secretary of Defense, came to a similar conclusion about "concurrences."

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this country," he said, "responsibility for the design and development of weapons is divided between military contractors and the military services.

"This division of responsibility is not known in the Soviet system, and it causes a considerable amount of delay in our system, particularly because contractors are often unable, except after the passage of a great deal of time, to get decisions from the military services on technical details of a weapon system."

Contracting Procedure

The Soviets have made their philosophy of technical competition and financial incentives workable through strict adherence to a contracting system that would be described in the U.S. as fixed fee or performance type contracting. As no real competition could exist without a fixed set of rules to compete by and some clear system of measuring achievement and distributing rewards, one of the main tasks of the Soviet planning authorities has been to draft clear contracts, that are called "work plans" in Russia.

No system of administering contracts or work plans could be completely free of friction or disagreements. The Soviet press reflects much of this type of conflict between the central planning authorities who write and administer the contracts and the industry groups that carry them out. Some of the reports sound as though they were taken directly from Renegotiation Board hearings in the U.S.

Most U.S. observers, however, agree that the Soviet government has carried through and awarded large bonuses and material benefits to successful designers, scientists and others connected with projects that met the terms agreed to in the initial work plan.

A brief description of the life cycle of a typical Russian aircraft project gives a more complete picture of Soviet competition, rewards system, contracting procedures and placement of the authority for design and development in the hands of the designers.

Majority of the Soviet projects pass through four distinct phases:

- **Planning to establish** a requirement for the weapon and selection of designers to compete in its development.
- **Design, development and flight** test of experimental aircraft.
- **Production.**
- **Operational use.**

Primary responsibility for, and authority over, a project changes in each of the four steps. One of the most significant points about the Soviet system is that design and production groups are separated financially. No good design group is dependent upon the amount of work that is allotted a production factory, and vice versa. Each

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separate group, whether design or production, stands or falls on the basis of the fullfilment of its own work plan with the state.

Initiation of a requirement for a new aircraft or any new weapon comes from several sources in Russia, and in this phase of weapon development, every country operates in about the same way. The original impetus can come from many quarters, high and low. The head of the state, whether he holds his position by force or by public consent, can call the attention of his experts to any possibilities which he thinks warrant attention.

Suggestions also can come from military commands, designers, research scientists and in some cases from people in unrelated occupations.

Regardless of the source of the suggestions, every nation has a group or groups of long range planners to study new ideas. The exact composition of the Soviet long-range planning groups for weapons is not precisely known. However, it undoubtedly resembles such groups for other areas of the Russian economy.

Planning Groups

Normally, the group concerned with new weapons consists primarily of members from the industrial ministries involved in weapon development; the Soviet armed forces; the Academy of Sciences of the USSR and its institutes; the intelligence service; high representatives of the Communist party; officials of the Gosplan, or central economic planning bureau of the Soviet Union, and officials of the Soviet banking system.

This planning group and its subgroups consider the present position of state-of-the-art research, the present work load of industry, the availability of resources, the estimated level of technology several years hence and many other factors in deciding whether a new weapon is feasible and desirable.

Once the decision has been reached to go ahead in a particular weapon area, very general specifications are laid down regarding desired performance.

The general specifications are transmitted to a State Commission in charge of choosing the design groups to compete in the development of the new aircraft. The Minister of the Aircraft Industry, or his personal representative, usually is a member of this commission, as well as top officials in the Ministry of Defense; representatives from the operational, maintenance, training and logistics commands of the Soviet Air Force; several prominent aircraft designers; production experts; members of the central planning and fiscal authorities, and experts from the USSR Academy of Sciences.

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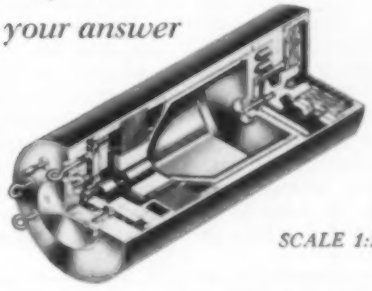

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uses a procedure similar to that used by the U.S. source selection boards to decide which design bureaus will be instructed to prepare a design proposal. Factors considered in the selection of competing designers include:

- **Nature, complexity and priority** order of the proposed design.
- **Degree and nature of specialization** of the design bureau.
- **Workload carried by the** design bureau at that time.
- **Past work experience** and success of the design bureau.

The selected design bureaus then prepare proposals as to how they would meet the general specifications laid down by the planning group. When these have been turned in, the Design Selection Commission compares them, primarily on the basis of estimated performance, cost and time of development and past performance of the design bureau.

Generally, two or more of the most promising proposals are ordered into development. A contract or work plan for each of these selected proposals is drafted on the basis of the estimates submitted by the design bureau.

The designers are thereby held to their original performance estimates and discouraged from making over-optimistic predictions in order to obtain a contract. The fact that they are competing with other competent groups keeps them from being ultra conservative in their estimates in hopes of exceeding the requirements of the work plan and receiving a bonus.

Main Requirements

A typical list of the main requirements laid down in an aircraft work plan include:

- **Maximum speed.**
- **Payload.**
- **Range.**
- **Rate of climb.**
- **Maximum altitude.**
- **Time required to complete flight evaluation.**
- **Cost of development** and testing.

Once the work plan has been completed and the necessary funds released to the design bureau, the chief designer is essentially on his own. He has primary control over the project and is answerable on technical matters only to the Minister of Aircraft Industry.

The chief designer, (Tupelov, Mikoyan, Antonov and a number of others hold this position) ordinarily is also manager of an experimental or development aircraft factory and has a large number of design groups or small collectives under his direct control. These various collectives are broken down roughly as they are in aircraft design plants the world over; one will deal with aerodynamics, another stress analysis, another with weights, etc.

The chief designer also is a weapon system manager in that he has the power to subcontract design work that he is not able to accomplish in his own experimental plant.

The Soviet text book, "Organization and Planning of an Aircraft Construction Enterprise," written by V. I. Tikhomirov and printed in 1957 by the State Publishing House for the Defense Industry, reports:

". . . A developmental aircraft plant, in designing a new aircraft model, subcontracts the work of designing and manufacturing installations for equipment to another development enterprise specializing in this field."

In this case, the chief designer pays for this work out of the money assigned to him for the project and has complete authority and responsibility for its adequacy.

Some larger equipment, such as engines, is developed under separate work plans at other experimental plants and supplied to the chief designer in much the same manner that government furnished equipment is made available in this country. There apparently is no set pattern for determining how much work the chief designer will subcontract.

First milestone in the development

of the new aircraft is the mockup review. A state commission is formed to handle this task. The commission consists primarily of representatives from the aircraft and defense ministries and from the Soviet Air Force. The powers and functions of the mockup commission are summarized by Tikhomirov's book, which says, the group has the right not only to express its comments on the mockup but, on the ground of its examination, to prescribe additional specifications for the design of the aircraft.

"The mockup is considered to have been definitely accepted and approved only after agreement has been reached between the mockup commission and the chief designer. The acceptance of the mockup is formalized by the commission in a formal instrument."

Usually two or three complete aircraft will be built by hand in the experimental aircraft factory, with the second aircraft, minus internal equipment, being subjected to static load testing. The others are used for obtaining a large amount of flight testing under the direction of the chief designer. First flight must be approved by the Ministry of the Aircraft Industry before it takes place.

This flight testing and extensive systems and structural testing on the ground allow the design to be verified or, if found deficient, to be improved before the flight test competition and final acceptance testing that takes place under a state commission.

The experimental factory normally has the equipment necessary to carry out this testing in its own laboratories and at its "LIIDB" (flight test and refinement base). If the necessary testing facilities are not available, the chief designer has the power to contract directly with another enterprise that can handle the work or he may have the equipment constructed to his specification.

Flight Test Competition

The primary function of the state flight test competition and evaluation is to choose a production aircraft from among the several competing experimental designs by getting accurate flight information on which to base a choice. However, the results of the final ground testing of structure, control systems and internal equipment that are conducted by the experimental plant also are monitored by the state commissoin and used in making its final selection of a production design.

In Tikhomirov's book, described by the author as the "first book of its kind," the operation of the state commission for aircraft evaluation is explained as follows:

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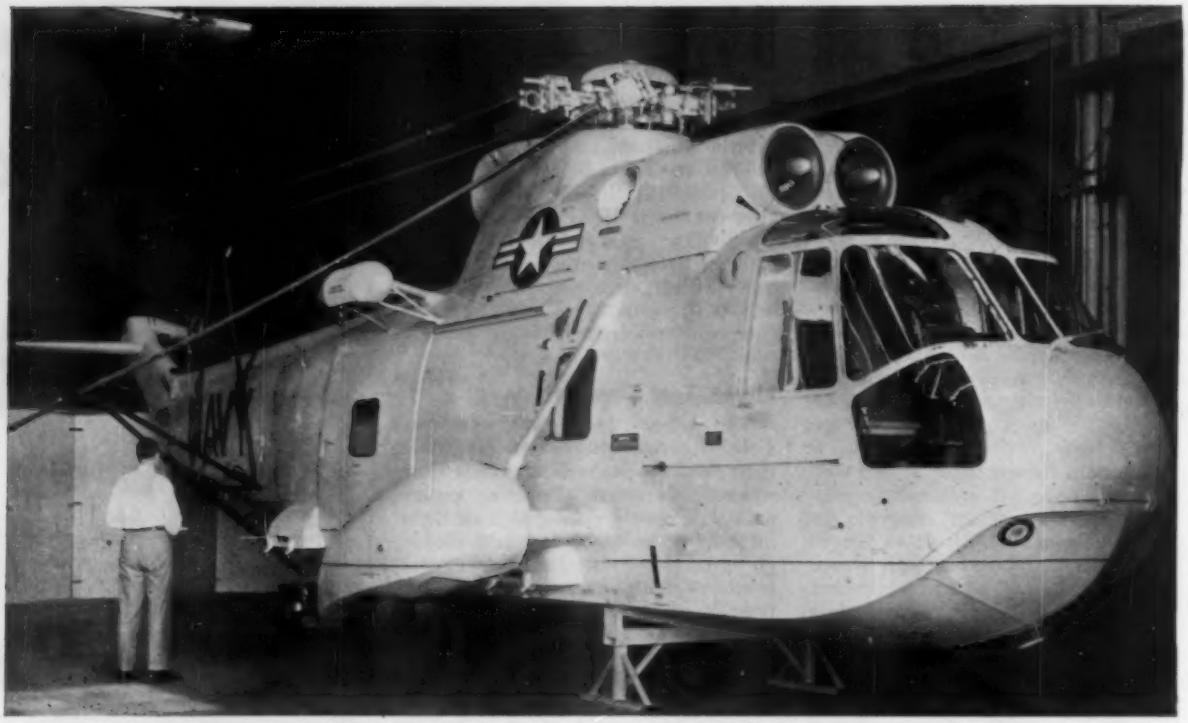

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"After the plant tests and the corresponding final modifications, the aircraft, together with its ground equipment, is turned over for the state tests, which constitute the certification of the aircraft for final delivery.

"The state tests of the aircraft are made by a commission under a special program and have the purpose of establishing the aircraft's compliance with the assigned specifications. The state tests are made on one aircraft or on several.

"When the state tests are run, any deviations from the assigned specifications, together with the purchaser's suggestions for improvement of the aircraft design, are entered in the protocol by the commission. If the aircraft on the whole meets the specifications, the committee enters a decision that the aircraft can be put into series production. At the same time, the commission, in agreement with the chief designer, establishes the order and date of introducing the supplementary modifications of the test protocol in the aircraft design."

Bonus Determination

The amount of bonus that the experimental aircraft plant will receive for its work is also determined by this commission.

Sometimes several aircraft which are in competition in one broad category are ordered into production if all do well in the state tests. This is believed to have happened with the new Soviet turbojet and turboprop airliners and now probably five modern aircraft are available for military or commercial transport duty.

Soviet mass production is conducted in "series" aircraft plants, which differ in many ways from the experimental plants which have control over an aircraft in the development phase.

The experimental plants are responsible directly to the State Ministry of the Aircraft Industry in Moscow, while the production plants come under the jurisdiction of the Councils of National Economy of the various economic regions.

The economic regions correspond roughly to the separate republics of the USSR. The economic regions are controlled by the state through the Gosplan in Moscow, but they have considerable latitude in directing the enterprises in their respective areas.

The experimental plants are financed out of the State budget and are considered subsidized. The production plants are termed "unsubsidized enterprises" and stand or fall on their profit and loss statement. They receive their initial funding from the state but have to sell to the Air Force at a definite price and show a profit.

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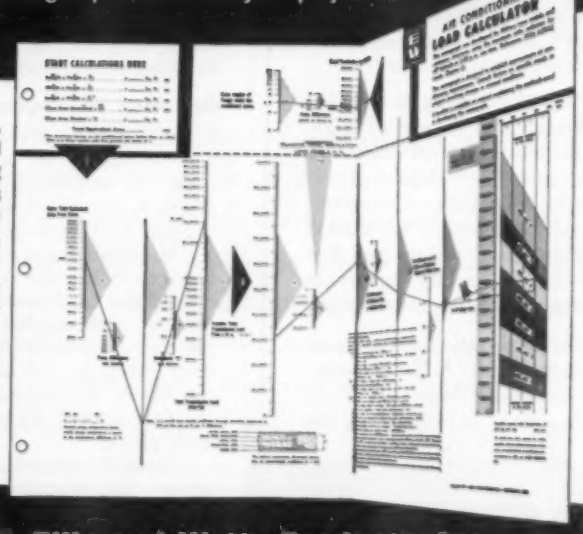

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Flight Safety Awards Presented

Three aviation figures and the U. S. Coast Guard were recipients of Flight Safety Foundation annual Distinguished Service Awards, presented on behalf of Aviation Week at the Atlantic City, N. J., Air Safety Seminar as Elwood R. Quesada (center), administrator, Federal Aviation Agency, and main speaker, looked on. Awards were presented by Jerome Lederer, (second from right) Foundation managing director, to (from left) Vice Adm. A. C. Richmond, USCG Commandant, for Coast Guard ditching techniques and rescues; A. Howard Hasbrook, director, Aviation Crash Injury Research, Cornell University, for crash injury and survival studies; Edwin A. Link, president, General Precision Instrument Corp., for design and development of training devices, and Otto E. Kirchner, operational consultant, Boeing Airplane Co., for leadership in design and structure of transport aircraft for increased safety. Nine countries, in addition to U. S. and Canada, were represented.

perimental plants is not development work covered by the state work plans and is considered unsubsidized. Therefore, the experimental plants have two sets of books to cover their activities in both fields. Their unsubsidized work usually is testing or minor design jobs for other development plants.

One-Man Management

Production plants are operated under the system of "one-man management" as are the experimental enterprises. A description of their autonomy is given by Tikhomirov's text:

"An unsubsidized enterprise (production plant) has the right to enter the competitive field independently and to contract with suppliers and consumers for the acquisition of raw materials, other materials, fuel and power and for the sale of its finished product (except for that portion covered by the state work plan).

"Business contracts regulate the economic interrelations between enterprises. The observance of contract discipline is one of the principal demands of the system of unsubsidized fiscal autonomy. The systems of contracts strengthens the responsibility of the enterprises for the fulfillments of the plans and for timely delivery of their products, and establishes a material responsibility for breach of contract.

"An unsubsidized enterprise has a complete system of accounting with a balance sheet showing profits and losses.

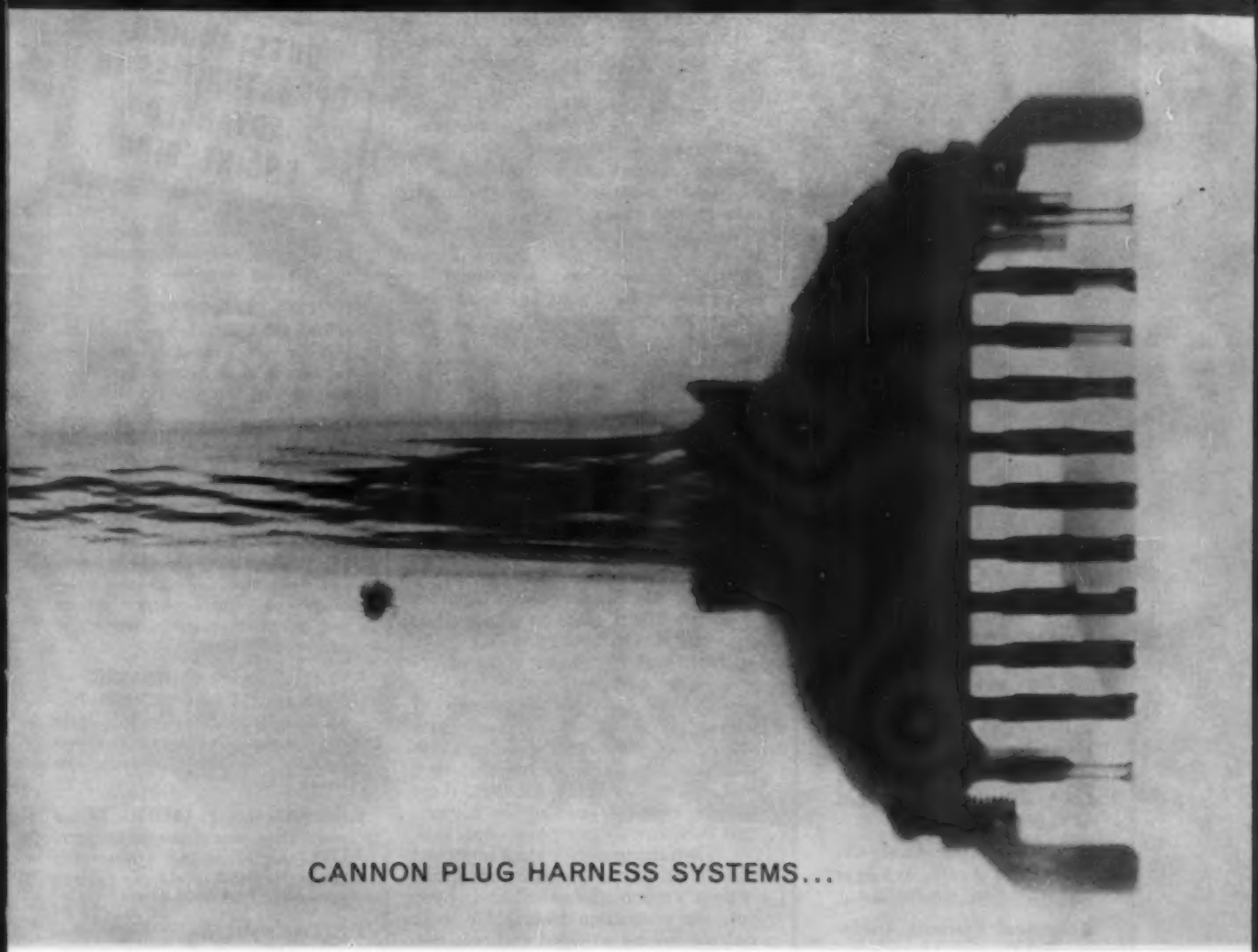
"The state increases the incentive for an unsubsidized enterprise to fulfill the plan by expanding the economic independence of the enterprise and making part of its profits available to supplement the working capital, capital investments and the funds of the enterprise."

Probably the greatest difficulty faced by the production plant is its liaison with the design bureau that developed the aircraft going into mass production.

Two basic relationships exist in this area. In the most prevalent situation, the design bureau has its own shop to build experimental aircraft.

Experimental Construction

In the other case, the experimental aircraft construction is handled by a "series" plant under contract to the design bureau. The latter method is generally used for very large aircraft such as the Tupolev intercontinental bombers Bison and Bear. It is reported that Tupolev is in charge of a "series" plant as well as the development design bureaus and that all of the experimental



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and production work for his aircraft comes under his personal direction.

Under either of these arrangements, the design bureaus are in a preferential position. Engineers working in the design bureaus make roughly 25% more in salary than the engineers in the production plants, depending upon their category. This situation apparently is a particularly sore one facing top Soviet management today.

Any technical change in an aircraft which the "series" plant deems necessary for improved production must be approved by the design bureau. These design changes to improve production are drafted and detailed by the "series" design bureau of the prime "series" plant and are then checked by the development design bureau.

Modification of the original design to improve performance or to correct operational deficiencies are handled through the development design bureau. Responsibility for, and authority over, the quality of the production aircraft is placed completely in the hands of the director of the prime "series" plant.

One of the fundamental techniques of Soviet mass production of aircraft as explained by Dr. Livingston is:

"Now here is a major point of departure between their procedures and ours. When designs are completed under the Soviet system, production tooling is authorized for all designs that look sensible. This means that they tool up at this point for, say, three weapon systems, knowing in advance that they are only going to produce one.

"When the prototype stage is reached and the prototype system is tested, two of these weapon systems will be dropped out, the production tooling for those systems will be scrapped and only one will be authorized for production.

"Under this procedure, the Soviets are not delayed by production tooling; and so, you see they get into production in one year whereas it normally takes us two and three-quarter years."

Operational responsibility of the Soviet Air Force, Aeroflot, or whatever agency happens to be the customer, begins when their pilots perform an acceptance flight test at the factory. Prior to that, pilots employed by the "series" plant have tested the aircraft in approximately the same manner U. S. manufacturers test production aircraft.

Britain Orders Australian Jindivik Target Aircraft

Britain has ordered 40 Australian Jindivik target aircraft for guided weapons trials in Cardigan Bay (Wales). Value of aircraft and spares is about $2¼ million, Ministry of Supply says. Latest version is powered by Armstrong Siddeley Viper ASV engine and flies at 60,000 ft.

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The Garrett Corporation has important assignments available in the following categories:

1. **ELECTRONIC AND FLIGHT DATA SYSTEMS AND CONTROLS:** Specialized experience with control devices utilizing servos, analog computers, Mach sensors and transitorized circuitry.
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5. **FLUID AND GASEOUS CONTROLS:** Design and development of gaseous nitrogen, LOX transfer, storage systems and converters and liquid gas cooling systems.
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7. **HEAT TRANSFER:** Aero and thermodynamic engineers for design of electronic cooling packages, evaporative heat exchangers and airborne heaters.
8. **SERVO-MECHANISMS AND ELECTRO-MAGNETICS:** Experience or training in design, development and application of magamps, injectors and transformers.

Forward resume to:

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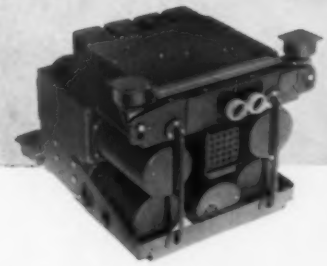
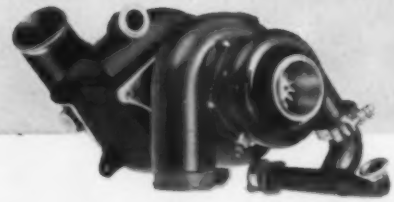
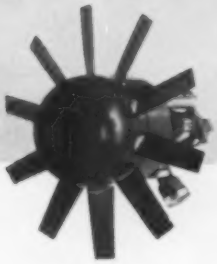
The A3J "Vigilante," equipped with vital AiResearch subsystems



Centralized Air Data Computing System



Refrigeration Package



Ram Air Turbine

North American Aviation's twin-jet A3J "Vigilante" is the Navy's newest attack weapon system . . . an all-weather, carrier-based, 30,000 lb. thrust aircraft which delivers both conventional and nuclear weapons from high or low altitudes at supersonic speeds.

Contributing to the success of the first aircraft produced under the Navy's weapon system management concept is the following AiResearch equipment:

AiResearch Centralized Air Data Computing System provides information for the major flight data subsystems dealing with bombing, navigation, engine inlet control, radar, automatic flight control and includes cockpit indicators showing true air speed, altitude and engine inlet air temperature.

AiResearch Environmental System Components for personnel and compartment air conditioning and pressurization include: cabin pressure regulators, safety valves, cabin refrigeration package, equipment compartment refrigeration package, primary heat exchangers, pressure suit heat exchangers and water-alcohol tanks for evaporative cooling.

AiResearch Ram Air Turbines provide power for operation of surface controls, instrumentation and landing gear in case of emergencies. Also included are miscellaneous valves and electro-mechanical equipment.

Systems engineering, support services and systems management have enabled AiResearch to integrate these vital subsystems into North American's A3J.

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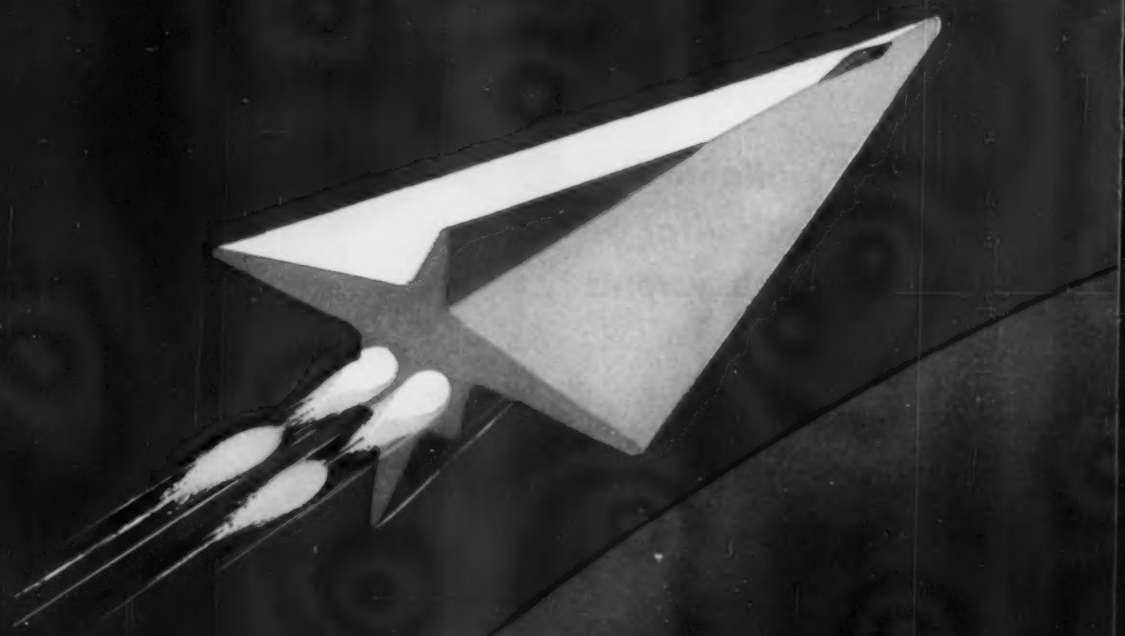
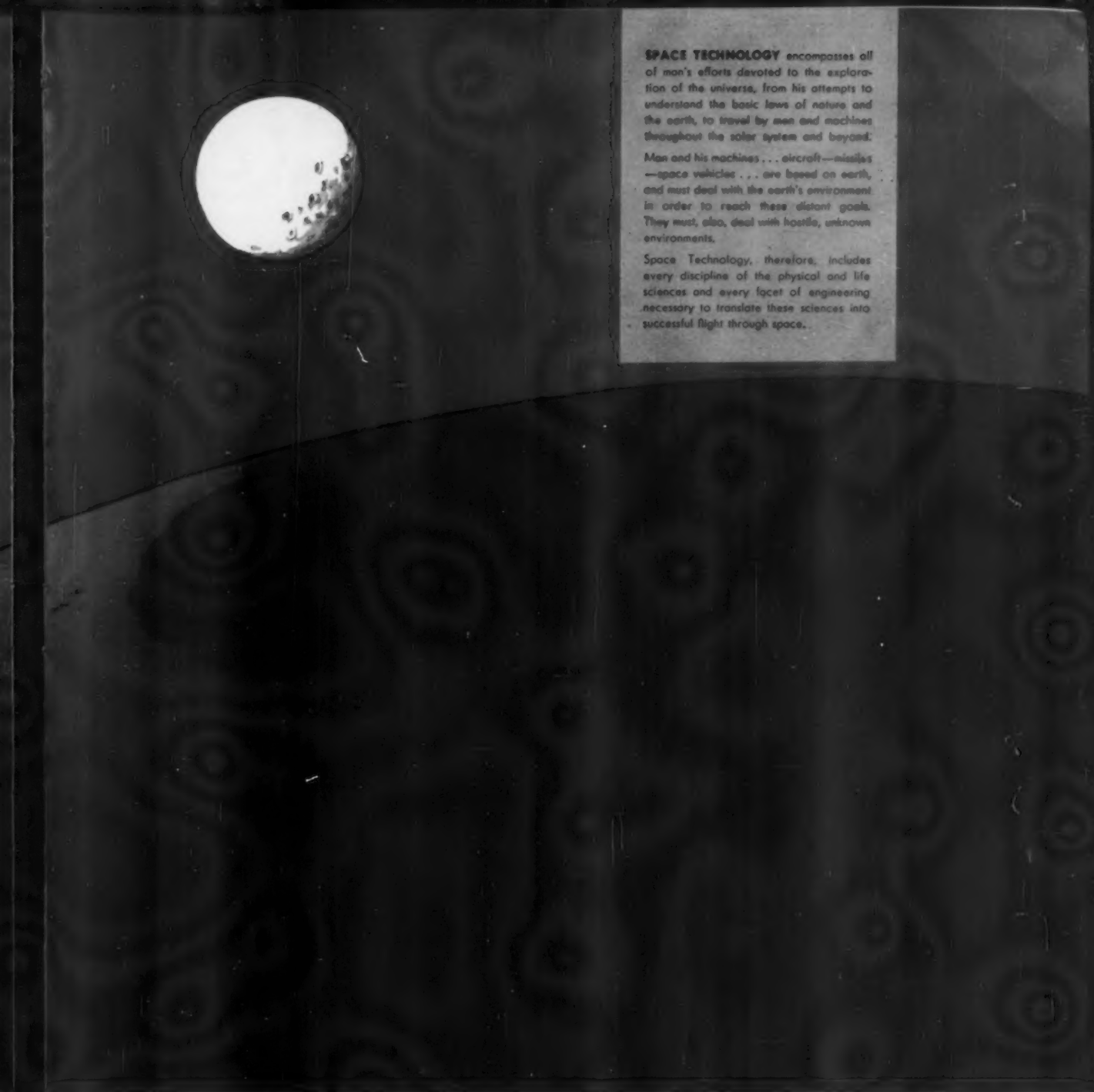
DYNA-SOAR...



DYNA-SOAR... An important step forward into the Space Age marked the award of preliminary design contracts for this advanced vehicle to the Glenn L. Martin and Boeing Aircraft Companies heading competing design teams. Dyna-Soar will be designed to glide around the world in a series of skips at speeds in excess of 17,000 M.P.H. Its mission is orbital reconnaissance, strategic bombing and aid in exploring the fringes of outer space.

Like other developments in Space Technology, Dyna-Soar, even though not scheduled to fly until the


SPACE TECHNOLOGY encompasses all of man's efforts devoted to the exploration of the universe, from his attempts to understand the basic laws of nature and the earth, to travel by men and machines throughout the solar system and beyond.
Man and his machines . . . aircraft—missiles—space vehicles . . . are based on earth, and must deal with the earth's environment in order to reach these distant goals. They must, also, deal with hostile, unknown environments.
Space Technology, therefore, includes every discipline of the physical and life sciences and every facet of engineering necessary to translate these sciences into successful flight through space.

1960's, will affect thousands of buying decisions tomorrow, next week, next month. AVIATION WEEK anticipated this kind of vehicle in its March 18, 1957 issue—has also described it in other technical articles—in the November 11 and December 16 issues of last year, and in the "Research for Space" edition of June 16, 1958.

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"Within and beyond lie many problems for our engineers: problems in aero and thermodynamic characteristics at supersonic speeds, in radar, in optics, in infrared and data processing for airborne detection systems. Additional long-range problems exist in military systems analysis, nuclear and space craft systems, commercial air transport studies, and industrial operations research.

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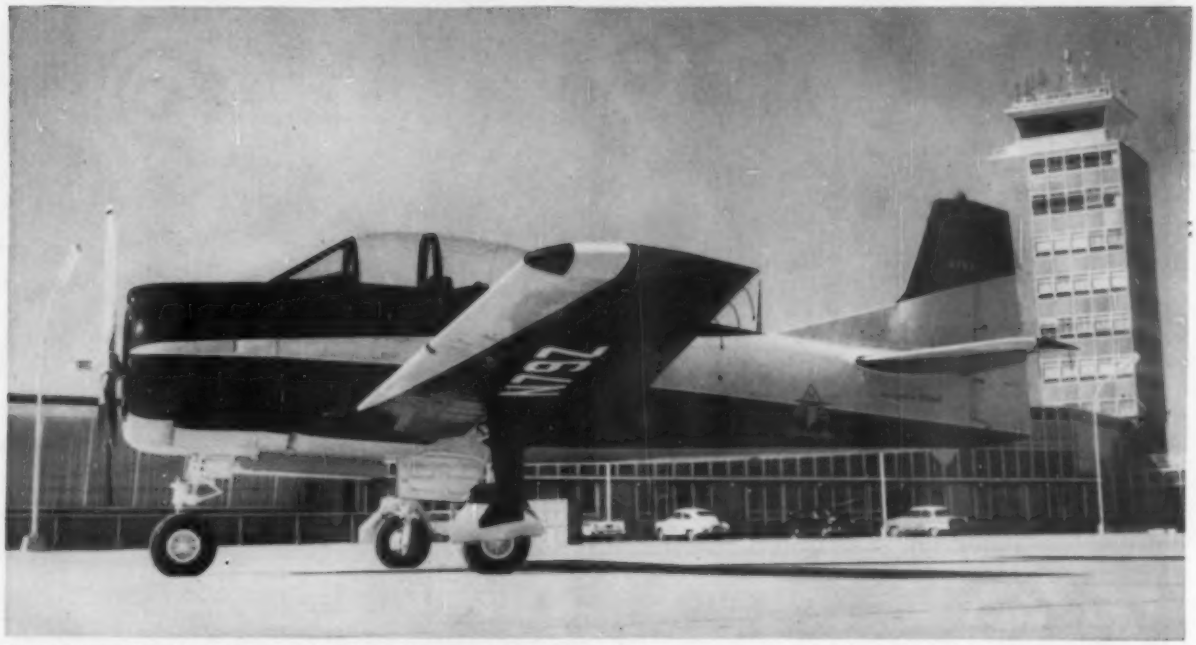


PROTOTYPE Nomad will be used by North American's Columbus Division as a transport and for pilot instrument proficiency checks.

T-28A Converted to Utility Transport

Conversion of surplus USAF North American T-28A trainers, combining the best features of this model with the engine of the Navy T-28B, has been developed by North American Aviation's Columbus, Ohio, division, for civil and military utility operation.

Named the Nomad, the conversion is designed for executive transportation, instrument proficiency checks, aerial survey operations or as an armament trainer for foreign governments.

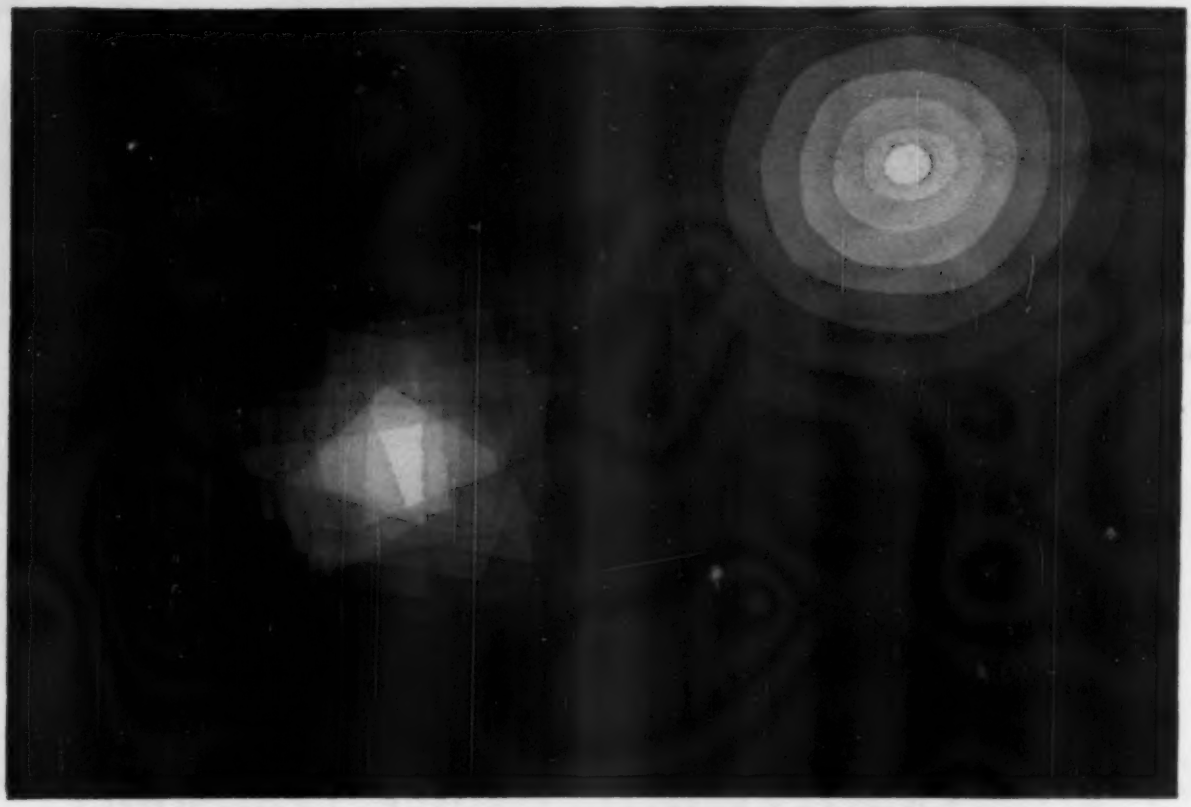
Nomad will start flight tests in December to obtain a Civil Aeronautics Administration type certification in the normal and utility categories. North American-Columbus has granted a license to PacAero Engineering Corp., Santa Monica, Calif., to merchandise and handle subsequent conversions. North American will retain the prototype for its own use in company pilot instrument proficiency checks and for transportation in support of military relations at various naval air stations.

North American reports that the Nomad conversion program was undertaken as a result of inquiries from foreign governments and on the basis of a market survey conducted by PacAero.

Basic feature of the remodeling program is the combination of a USAF T-28A fuselage with a Navy T-28B Wright R1820-56 engine delivering 1,350 hp. and a three-blade Hamilton Standard Hydramatic propeller provid-

Jetstar Prototypes Shown Together

More than 70 production positions for the Lockheed Jetstar 600 mph. utility transport have been sold to private companies (AW Nov. 17, p. 41). First prototype is at right. Second prototype (left) is equipped with slipper tanks (300 gal. each) for long range capability



"EARTH IN SPACE," one of a series of paintings of the planets by Simpson-Middleman, painters who have been finding their subject matter in science. To quote them: "Earth is distinguished among the planets by its oceans of water and its single moon. From these as a starting point, earth in this painting has been imagined as a configuration of intersecting planes—layer on layer of blue—until it becomes a transparent crystal, glowing in space." Painting courtesy John Heller Gallery, Inc.

Space power

The newest, most advanced Air Force missile project is Minuteman—a weapon system built around solid-propellant intercontinental ballistic missiles. Minuteman is under accelerated development for use by the Strategic Air Command, with the Air Force's Ballistic Missile Division managing the program.

Boeing is associate prime contractor for Minuteman assembly and test—an assignment that came to the company in recognition of its missile and system integration experience, its outstanding facilities and research capabilities. Boeing's organization, research and manpower resources have been geared to meet the complex technological needs of the space age.

Engineers and scientists at Boeing are at work on other advanced research and development projects, including Dyna-Soar, a manned space vehicle that will orbit the earth at speeds approaching 18,000 miles an hour, and be capable of re-entering the atmosphere and making a normal landing.

Minuteman, Dyna-Soar and other advanced projects at Boeing offer exceptional space-age opportunities to engineers and scientists of all categories. Drop a note to Mr. Stanley M. Little, Department C-82, Boeing Airplane Company, Seattle 24, Washington.

BOEING

ing optimum cruise performance. Other changes include a new engine cowling, engine mount and hardware, additional fuel in outer wing panel, relocation of certain equipment aft to retain balance, different metering pins in the landing gear and some strengthening of forward fuselage and tail. Cockpit has been modernized and new radio equipment added. Engine installation is similar to the Learstar power pack on PacAero's executive conversion of the Lockheed Lodestar, according to North American.

Current operating gross weight is 7,900 lb. Airplane has a limit load factor of 7.9Gs. Cruise speed is stated to be 305 mph. at 20,000 ft. at 65% power. Service ceiling is 38,000 ft. and range is 1,100 stat. mi. Ground roll for take-off is given as 715 ft. and landing roll is approximately 1,430 ft.

Custer Channel Wing Production Planned

A five-place version of the Custer Channel Wing will go into production in Canada next spring and will be offered in the United States at a price of approximately $55,000, according to J. W. Frazer, a founder and president of former Kaiser-Frazer Corp. Frazer and Willard R. Custer, designer of the Custer Channel Wing, have formed the Custer Frazer Corp., New York City.

The Custer CCW-5 will be manufactured in Canada by Noorduyn Norseman, Montreal, under an agreement with Custer Frazer, with final assembly in the United States, Mr. Frazer told AVIATION WEEK. Under consideration is a site in Arizona and at Canton-Akron (Ohio) Airport, he noted. Production model will feature 260-hp. Continental engines replacing the 220-hp. powerplants in the prototype; landing gear will be located under the wing channel sections and fuel will be in the wingtips.

Prototype CCW-5 has accumulated more than 100 hr. of flight test experience, Frazer states.

Flying Medics Plan Disaster Operation

A disaster assistance program, utilizing the services of the 1,500 pilot members of the Flying Physicians Assn. to gather necessary medical specialists in shortest possible time, has been developed by the association for utilization by the government at no cost.

The 1,500 flying doctor members of the association are capable of quickly assembling several hundred airplanes, each with a doctor, two trained nurses and an important cargo of medical supplies, at any point in the U. S. Supplies would include surgical instruments

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HAROLD E. ROGERS, CHESTER, CALIF., *flying ambulance missions over the Sierra.* "The last time my Cessna 170 got its 800-hour overhaul, I found the rings still had the original machine marks."

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and sterilizing agents, narcotics and sedatives, antibiotics and sulfa derivatives, immunizing agents and vaccines, antiseptics, sterile cotton, gauze dressings and blood replacement agents.

Flying Physicians Assn. notes that normal dispersal of the aircraft would preclude them from all being destroyed in the event of disaster. Aircraft's small size makes them especially adaptable to landing at unprepared sites, close to the scene of trouble.

The association reports that cost of duplicating currently available facilities, as operated by its membership, would approximate $45,750,000. It breaks this down as follows: 1,500 aircraft, with instruments and equipment, $22.5 million; 1,500 hangars, $7.5 million; 1,500 pilots in standby and training at $5,000 per year, $7.5 million; 1,500 M.D.s in reserve status at $1,000 per year, $1.5 million; 3,000 nurses in reserve status at $1,000 per year, $3 million; fuel, maintenance, etc., for training, per year, $1.5 million; administration and organization expenses, per year, $1.5 million and surgical and medical equipment and supplies, $750,000.

The association further notes that the program, if used by the government, could readily be extended beyond its 1,500 pilot-medic membership through voluntary cooperation with owners of private planes who would agree to transport non-flying physicians and equipment to stricken areas in an emergency.

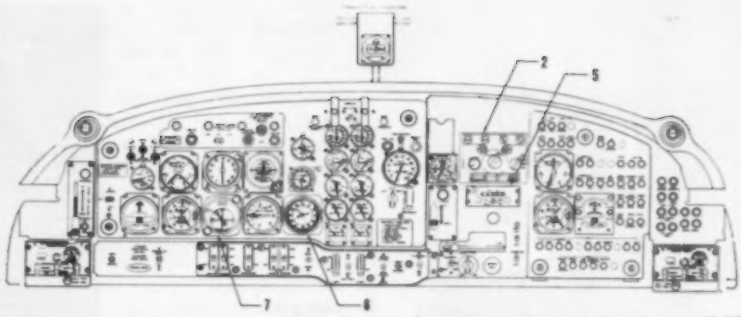
Range of Avionics Extended in T-37A

Completely new communications and navigation equipment for the Cessna T-37A twin-jet trainer has been approved by USAF and will be installed in mid-1959. Improved mission capabilities are expected with installation of the new equipment; the original gear has been a source of complaints on the basis of insufficient range, AVIATION WEEK noted in its pilot evaluation of the T-37A (AW Apr. 1, 1957, p. 48).

The equipment is being installed in a prototype aircraft for exhaustive testing, expected to last some six months.

The modification involves installation of the following equipment: ARC-34 UHF receiver-transmitter providing 8-10 watt peak on each of the available 1,750 channels. Twenty preset channels are available; these may be reset by the pilot. Any of the remaining channels can be selected individually by the pilot. The pilot can select the "Guard" channel at any time by switching from "Preset" to "Guard" at the channel selector on the control head. Current equipment has only one-half watt output.

A 101 VOR system provides continu-



USAF has approved new communications and navigation equipment for Cessna T-37A. Panel includes: 2—C-1057 ARC-34 control head (receiver-transmitter); 5—614U-½ omni control head; 6—ID-250/ARN radio magnetic indicator; 7—ID-387/ARN course indicator.

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ous omni bearing automatically when proper frequency is selected. Frequencies can be chosen in 100 kc. increments from 108 to 135.9 mc. The ID-250/ARN radio magnetic indicator provides a bearing to the omni station as well as an aircraft heading indication. An ID-387/ARN provides course indication.

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PRIVATE LINES

New Lycoming IGSO-480-A1A6 fuel injection version of 340-hp. geared and supercharged six-cylinder engine for business airplanes will be installed on 1959 model of Beech Twin-Bonanza. Engine is also on improved L-23F Twin-Bonanza for U. S. Army (AW Nov. 17, p. 118). Powerplant is equipped with Simmonds 570 fuel injector having automatic altitude mixture compensation. Fuel consumption at 75% rated power is 20 gph.; at 65% power, it is 17.5 gph. and at 60%, it is 15.8 gph. By mounting fuel injector on rear of engine, Lycoming reports engine's over-all length is decreased by 10 in. compared with carburetor version.

Follow-on contract valued at more than $2 million, covering remanufacturing of additional quantity of L-23 Twin-Bonanza liaison planes to L-23D configuration has been awarded Beech Aircraft Corp. by U. S. Army. Award supplements initial contract for $1,710,000, extends program to July, 1959.

Project All-Jet, beginning this month at Bainbridge Air Base, Ga., will provide 38 primary students with complete training in Cessna T-37A twin-jet aircraft. Students currently receive 30 hr. in piston-engine Beech T-34A primary trainers before going to T-37A, where they receive 100 hr. Students in Project All-Jet will get 115 flying hours, all in T-37As. An identical group in the same class at USAF's primary school, operated here by Southern Airways under contract, will take normal course for basis of comparison.

Fixed base for executive aircraft maintenance, overhaul and conversion has been opened by Remmert-Werner, Inc., at Mercer County (N. J.) Airport, in hangar formerly occupied by Strou-

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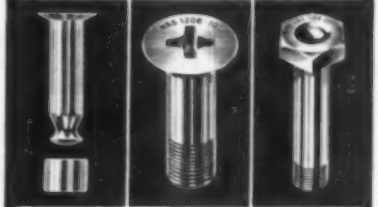

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The Division is systems manager for such major, long-term projects as the Air Force Earth Satellite, Q-5 and X-7; Army Kingfisher; Navy Polaris IRBM and other important research and development programs. It was honored at the first National Missile Industry Conference as "the organization that contributed most in the past year to the development of the art of missiles and astronautics."

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Flight Test Evaluation Advanced degree required in A.E., M.E., E.E., physics or math with minimum 5 years' experience in one or more of the following: technical control of missile systems tests; analysis and evaluation of missile systems performance; preparation of systems reports; missile flight test activities in blockhouse, countdown and launching operational performance evaluation. Liaison with the military is an important part of these assignments.

Flight Test Operations B.S. in A.E., M.E. or E.E. with 5 years' experience in missile flight test operations for blockhouse, countdown and launching activities. Liaison with the military is an important part of the assignment.

Theoretical Physics M.S. in physics required, Ph.D. preferred, with experience in space physics, or nuclear physics applications; infrared and other detection methods, with ability to evaluate flight test program effectiveness.

■ **For information** regarding these and other related positions, please write: Research and Development Staff, Dept. 1711, 962 W. El Camino Real, Sunnyvale, California.

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Major aerial survey, including photo mapping at 25,000 ft. and ground profile recording to provide specific and accurate records for eventual mapping, is currently being handled by Spartan Air Service (Eastern) Ltd., Nairobi, Kenya, for Mozambique, Portuguese East Africa.

Long-range fuel system for Cessna 310 light twin business plane provides total capacity of 330 U. S. gal., endurance of over 18 hr. and still air range of over 3,000 naut. mi. at normal cruise power settings. System provides two 100-gal. tanks mounted in fuselage behind front seats; if desired, one 100-gal. tank can be installed permitting use of one rear seat, on the right side. Left tank has booster system permitting fuel feed from long-range tanks in event of engine fuel pump failure. System was developed by Rural Aviation, Ltd., New Plymouth, N. Z. System for carrying and airdropping eight standard-size bales of hay from a Cessna 180 also has been developed by Rural Aviation. System utilizes a large open-frame cage under each of the plane's wings, fitted to standard supply dropping racks; doors under cages are opened to release hay by means of a solenoid easily operated by a button on airplane's control column.

LearCal opened sales and service facility in the International City Building, 4471 N.W. 36th St., Miami, in line with expansion of its line of communications, control and navigation equipment for business and airline aircraft. New office is managed by E. A. Bostelmann.

Four Piper Comanches are being delivered to Sudan Interior Mission, Jos, Nigeria, for use in organization's missionary, educational and welfare work in central and northern Africa. Comanches will replace the former fleet of five lighter and slower aircraft used by the mission.

Piper Comanche number 500 was delivered this month just 10 months after first airplane was handed over to a customer. Comanche number 500 went to a 58-yr.-old Texas businessman and rancher, is a 250-hp. Autoflite model. Piper currently is producing four Comanches per working day at Lock Haven, Pa.

WHAT'S NEW

Publications Received:

Solid Propellant Rockets—by Alfred J. Zaehringer—Pub. American Rocket Co., Box 1112, Wyandotte, Mich. $8.00; 306 pp.

This book brings you up to date on solid propellant rocketry. It contains data on almost every solid rocket, data tables, graphs, drawings plus a large collection of photographs.

Nuclear Rocket Propulsion—by R. W. Bussard and R. D. DeLauer, Los Alamos Scientific Laboratory, University of California—Pub. McGraw-Hill Book Co., Inc., 330 West 42nd St., New York 36, N. Y. $15.00; 370pp.

Comprehensive report bringing together the reactor physicist and engineer with work of the rocket and missile designer.

Aircraft Communications Systems—by J. H. H. Grover, A.R.Ae.S., M.I.N., Philosophical Library, 15 East 40th St., New York 16, N. Y. $4.75; 127 pp.

This book will bring an experienced flight radio operator up to date with modern equipment, and will also be of value to all students working for their license.

Sputnik Into Space—by M. Vassiliev with Prof. V. V. Dobronravov, Soviet Academy of Science; The Dial Press, Inc., 461 Fourth Ave., New York 16, N. Y. $3.75; 181pp.

This book provides a glimpse of the present and future Russian rockets, satellites and missiles.

Reports Available:

The following reports were sponsored by the Office of Technical Services, U. S. Department of Commerce, Washington 25, D. C.

A Rotatable-Magnet Permeameter—by R. K. Tenzer and M. A. Bohlmann, Indiana Steel Products Co., for Wright Air Development Center, U. S. Air Force. $50; 9pp.; (PB 131352).

Double Inhibit Magnetic Matrix Switch—by L. F. Silva, Aberdeen Proving Ground, U. S. Army. $.50; 15pp.; (PB 131353).

State of Development of Thermal Radiometer—by A. Pfenninger, H. E. Henry, M. Godet, and C. Z. Wogrin, Quantum Inc. for Wright Air Development Center, U. S. Air Force. March, 1958. $1.50; 57pp.; (PB 131746).

Procedure for Determining Vapor Pressures of Materiels of Low Volatility—by Q. M. Ballentine, Wright Air Development Center, U. S. Air Force. February, 1955. $.75; 20 pp.; (PB 131469).

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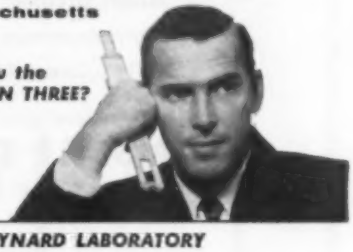

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WHO'S WHERE

(Continued from page 23)

Changes

Brig. Gen. Wayne H. Adams (USMC, ret.), military requirements analyst, Sylvania Electronic Systems, a division of Sylvania Electric Products, Inc., Waltham, Mass. Gen. Adams' office will be in Washington, D. C.

Arthur W. Vance, head of newly-formed Information Processing Research Department, Hughes Aircraft Co., Culver City.

Roger J. Kuhns, manager-government marketing, and Kendall Clark, manager-military engineering, American Bosch Division, American Bosch Arma Corp., Springfield, Mass.

Roy C. Ritchert, assistant chief engineer, General Dynamics' Stromberg-Carlson Division, San Diego, Calif.

Capt. Martin W. Mason (USN, ret.), manager-Navy liaison, Allison Division of General Motors, Indianapolis, Ind.

General Electric Co.'s Missile and Space Vehicle Department, Philadelphia, Pa., has announced the following appointments: **Mark Morton,** manager, re-entry vehicle project operation; **Howard M. Wittner,** manager of space vehicle project operation; **William R. Eaton,** manager, quality control and test operation; **Bernard H. White,** legal counsel; **C. D. Greentree,** manager, operations analysis; **A. W. Robinson,** manager, future growth study. **Leo Steg** continues as manager-aerosciences laboratory, and **C. Herbert Ridgley** continues as manager, missile production section at Burlington, Vt.

Dr. Samuel Herrick, special consultant, Airborne Equipment Department, Librascope, Inc., Los Angeles, Calif.

Ed Cokeley, director, North American Aviation's flight test operations at Edwards AFB, Calif. **Murray O'Toole** replaces Mr. Cokeley as group leader of engineering flight test at North American's Palmdale, Calif., facility.

L. Richard Bell, Jr., chief project engineer, Sundstrand Turbo, a division of Sundstrand Machine Tool Co., Pacoima, Calif. Mr. Bell continues as chief design engineer. Also: **James A. Reeves,** project control manager-Atlas program.

Dr. Lee Arnold has been appointed professor and chairman of the department of aeronautical engineering and director of the Daniel Guggenheim School of Aeronautics of New York University's College of Engineering, New York, N. Y.

Capt. Carlos Hiller, technical manager, LAV, the Venezuelan Airline. Also: **Andres A. Betancourt,** general manager, LAV's Miami office.

George H. Bancroft, Nike-Zeus radar coordinator, Manufacturers Products Division-Customer Relations, Goodyear Aircraft Corp., Akron, Ohio.

Robert Duff Clark, chief engineer, Clary Dynamics, San Gabriel, Calif.

W. R. Clay, assistant to the vice president of engineering, Radioplane Division of Northrop Aircraft Inc., Van Nuys, Calif.

Leo W. Tobin, Jr., manager, Milwaukee, Wis., operations, AC Spark Plug Division of General Motors, Flint, Mich. Also: **Algie A. Hendrix,** assistant manager of AC-Milwaukee operations.

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P-9324, Aviation Week
520 N. Michigan Ave., Chicago 11, Ill.

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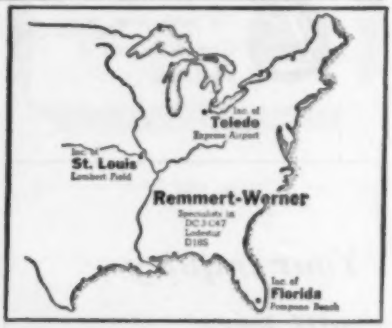

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LETTERS

Runway Lighting

Capt. Robson's article, "The CAA Stands Alone," (AW Sept. 29, p. 31), would have been more convincing had he not lifted a sentence from out of context to make it appear that no one would accept responsibility for CAA Technical Report No. 338. The complete paragraph makes it quite clear that the Office of Technical Services assumes no responsibility since the report originated in another agency. This is a standard notice used on all such reports printed and offered for sale to the public by that office.

Did the CAA "stand alone" in the decision to install floodlights at Washington National Airport? The Airline Transport Assn. made the following recommendations to CAA: "Because of the potentialities of floodlighting, we would urge that the available experimental units be promptly relocated to an active airline airport so service testing of utility of such lighting can be expedited. An airport having configuration "A" approach lighting with flashers (such as Newark, Idlewild, or Washington) should be selected. We would have no objection to moving these floodlights to Washington National for further tests—in fact, would be very happy to thus expedite their evaluation." The National Business Aircraft Assn. summed up its comments to the CAA with the following recommendation: "In brief, we believe that additional testing is required and look forward to the Washington National Airport experiments."

The statement that, "It was apparent at the beginning of this program that CAA personnel were against flush lighting and were attempting to 'sell' edge lights . . . ," to be factual should have been written, "It was apparent at the beginning of this program that CAA personnel did not believe that narrow beam lights would perform as well as wide beam lights in the narrow gage system." (Narrow beam lights in the narrow gage create an unbalanced light pattern when only a few feet from runway centerline. Actually, no one was more surprised than the CAA when the floodlights performed so well in the zero-zero weather at Andrews Field.

Before edge floodlighting was installed at Andrews Field, Jim Harding and I had flown the narrow gage system in visibilities down to one-quarter mile and we both experienced difficulty in judging aircraft height at touchdown (aircraft landing lights were not used). This system was 3,000 ft. in length. However, with only 750 ft. of edge floodlighting, which commenced 500 ft. from the runway threshold, Jim and I were both able to land in the floodlighted area with consistent precision in visibilities down to 700 ft. runway visual range. (Capt. Robson did not land at any time, but made low passes. In other words, he tested the lights as approach lights only.)

Capt. Robson infers that the CAA is gathering pilot comments on Washington National Airport floodlighting in weather above 500 ft. ceilings and one mile visibilities in order to obtain favorable comments. Our instructions to the airlines receiving the questionnaires requested that the forms be attached to flight releases when a flight was scheduled to land during the hours of darkness when the visibility was at or below one mile.

Aviation Week welcomes the opinions of its readers on the issues raised in the magazine's editorial columns. Address letters to the Editor, Aviation Week, 330 W. 42nd St., New York 36, N. Y. Try to keep letters under 500 words and give a genuine identification. We will not print anonymous letters, but names of writers will be withheld on request.

An important reason for developing runway edge floodlighting is that there will be about 214 ILS installations commissioned in the U. S. by 1961, and many of these locations need improved lighting systems. It is generally conceded that we cannot "tie up" a busy airport for the time required to install narrow gage systems in the runway surface.

When a government agency conducts an evaluation program, such as the one in question, unless security reasons dictate otherwise, it is obligated to make a report of its findings available to the public. The CAA has had numerous requests for the test results at Andrews Air Force Base and Report No. 338 has been used to supply this demand.

ROBERT F. GATES
Flight Operations Specialist
Civil Aeronautics Administration
Washington, D. C.

(The foregoing letter was forwarded to Capt. Robson, and following is his reply.—Ed.)

Mr. Gates is avoiding the issue. The point is that there are enough seals and names and official titles on Report 338 to cause many people (especially people in other countries as I specifically pointed out) to believe that this is a complete and factual report and one which has some standing in its field. The only "fact" here is that it represents the feelings of a few people in CAA.

In regard to the floodlight installation at National Airport, it is indeed true that many people advocated this location—I also concurred. This is not the issue either. The problem is that CAA is attaching weight to reports obtained in weather which is of little significance. CAA is using these reports, from pilots who have not had the opportunity to fly the narrow gage lights, to bolster their position on edge floodlighting.

Landings were not undertaken on the Andrews runway by the Convair 240 due to its small propeller ground clearance. My column on the subject (AW July 29, 1957, p. 47) stated: "Since the installation was temporary, the various fixtures were simply placed on top of the runway surface. Because of these steel and concrete obstructions actual touchdowns were avoided. Generally we maintained a safe altitude of 10 to 20 ft. above the pavement although all pilots agreed that if the lights had been flush-mounted normal safe landings could easily have been made."

When a government agency (or anyone else for that matter) conducts an evaluation it certainly is obligated to report its findings. It is also obligated to report its findings in an unbiased fashion. Report 338 obviously devotes half its space towards building up a negative case against narrow gage lights, then proceeds to idolize floodlighting. In this it fails to consider the results obtained by other people connected with the evaluation—people whom the CAA is supposed to represent and whose views were made known in an open meeting. This is the type of obstinate bureaucracy which has helped doom the CAA and which all of aviation hopes will disappear under Mr. Quesada.

R. C. ROBSON
Arlington, Va.

Rules Exist

Over the name of H. B. Davis, Burbank, Calif., in the Sept. 1 issue of AVIATION WEEK (p. 90), appears a letter entitled "Lightplane Rules." Mr. Davis asks for regulations and control of lightplanes and states the instance of a student pilot taking off with two passengers from an unlighted runway at night after a midnight party, which suggests the pilot being drunk or, at least, having been drinking.

Obviously, Mr. Davis is not a pilot. He apparently does not know of the extent of air regulations regarding flight of private aircraft, or he would not have written this letter asking for additional regulations. The pilot of the flight in question only disregarded 30 or 40 long-established regulations (which were known to him since he had a student license), among them being: he was not permitted to fly at night; not permitted to carry passengers; not permitted to fly from an unlighted runway.

Mr. Davis does not say anything about all the accidents and deaths caused by this same type of person getting into cars and driving after midnight parties, but you have the same circumstances and the same loss of life and property. It seems there will always be some people foolish enough to drive after drinking and, unfortunately, some of these people have a pilot or student license. I suppose the pilot in question was killed, and probably the passengers. Should the pilot have lived the penalty should have been very heavy and severe, not only to compensate for damage but to make an example as warning to others. But, new and more rules? What good could they do? We have rules against such things, including murder, but they still happen.

Fortunately, deaths from lightplane accidents are decreasing all the time. Weather accidents still take their toll, but are being cut down by better equipment, better cross-country planes, and better instrument training for the pilots. The "buzzing," or show-off accidents are decreasing, too, as students are taught more in the line of cross-country travel instead of flying for thrills.

Perhaps if Mr. Davis would just enroll at the nearest airport for a course of instruction he would see that the rules and regulations are there, but it still takes some common sense and in some this is lacking.

GEORGE M. SAGER
Williamsburg, Va.

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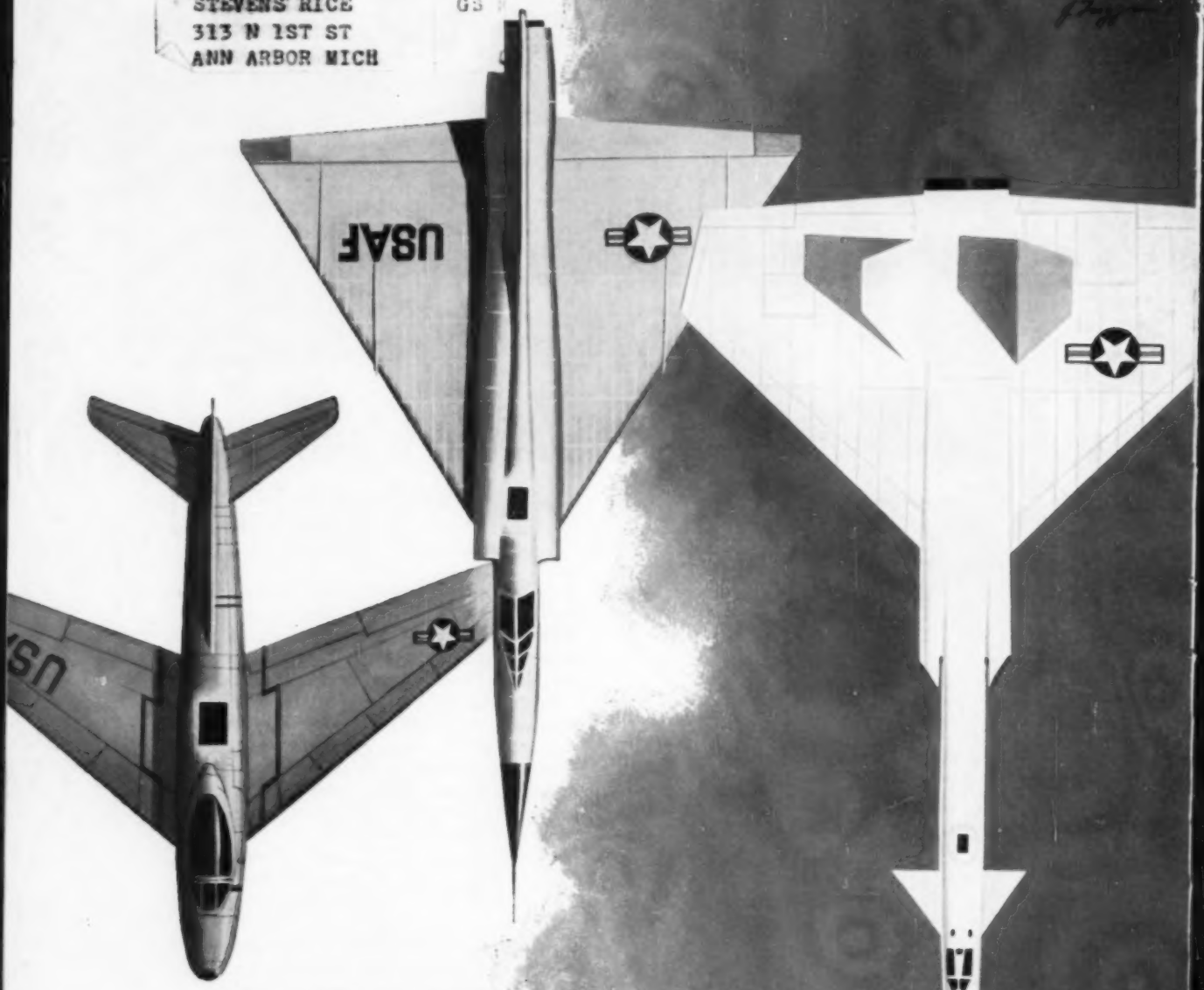

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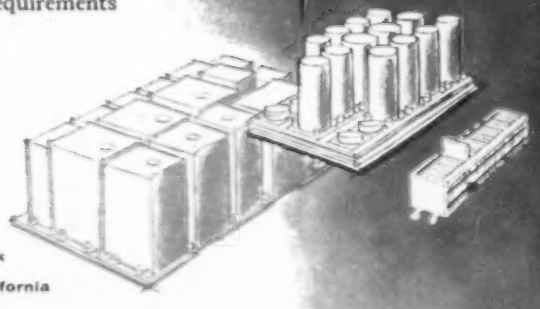

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